AD-A190 771 LGM-30B STAGE II DISECTED MOTOR TEST REPORT(U) OGDEN AIR LOGISTICS CENTER HILL AFB UT PROPELLANT ANALYSIS LAB OCT 87 MAQCP-NR-528(87) 1/1

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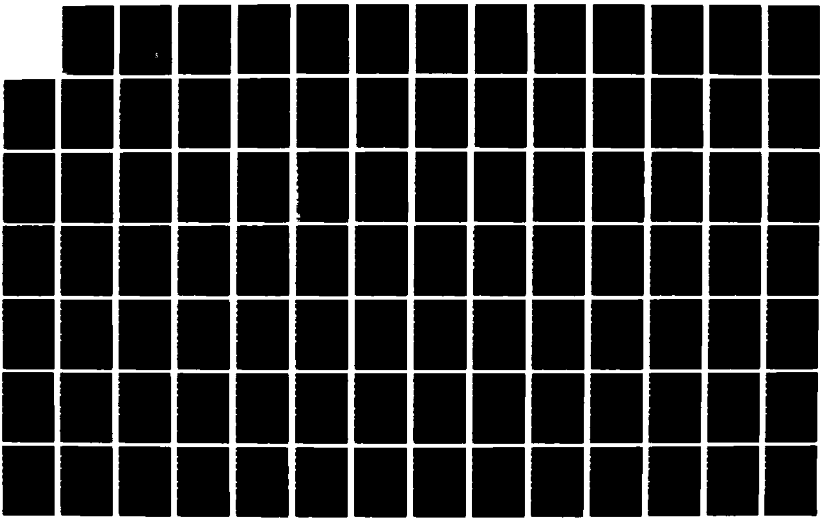

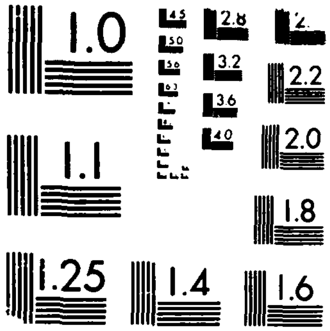

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NATIONAL BUREAU OF STANDARDS-1963 A

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UNITED STATES AIR FORCE
HILL AIR FORCE BASE, UTAH 84056

LGM - 30B
STAGE II
DISSECTED
MOTOR
TEST REPORT

PROPELLANT ANALYSIS LABORATORY

MAQCP-REPORT NR 528 (87)

OCTOBER 1987

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QUALITY INSPECTED 2

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LGM - 30B
STAGE II
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TEST REPORT

AUTHOR

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Project Title: LGM-30B, Stage II, Dissected Motor Test Report

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Data in this report represent the second testing of Motor 0022687 with conditioning. Additional unconditioned specimens were tested so that data could be related to previously tested unconditioned specimens. Data points are shown on multi-motor plots previously published. These plots are for visual reference only. Effects of conditioning are noticeable in almost all tests and relationship to other test periods shows marked differences. No effort has been made to evaluate statistical significance.

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GLOSSARY OF ABBREVIATIONS AND TERMS

Aging Trend	A change in properties or performance resulting from aging of material or component
CHS	Cross head speed, the speed at which the pulling jaws separate
DTA	Differential Thermal Analysis
E	Modulus (psi), defined as ratio of normal stress to corresponding nominal strain
EB	End Bonded specimens
EGL	Effective gauge length
em	Strain at maximum stress (in/in), nominal
er	Strain at rupture (in/in), nominal
E(t)	Stress Relaxation Modulus
Failure Criterion to	Defined as measurable performance parameter or material property limit which, if exceeded, will cause the motor fail to perform within model specification requirements
"F" ratio	The ratio of variance accounted for by the regression function to the random unexplained variance. The regression function having the most significant "F" ratio is used for plotting data. The ratio is also used in detecting significant changes in random variation between succeeding time points
JANNAF	Joint Army, Navy, NASA, Air Force Interagency Propulsion Committee
MAQCP	Propellant Laboratory Section, Directorate of Maintenance, Ogden Air Logistics Center
MMWGR	Propulsion Engineering Section, Mechanical and Aero Engineering Branch, Directorate of Materiel Management, Ogden ALC
Ogden ALC	Ogden Air Logistics Center, Air Logistics Command
r or R	The correlation coefficient is a measure of the degree of closeness of the linear relationship between two variables

Regression Equation	The general form of the regression is Y = a + bx where Y = projected test value at the independent variable months(x), a = y axis intercept of regression trend line and b = the regression trend line slope
Regression Line	Line representing mean test values with respect to time
Sb	Standard error of estimate of the regression coefficient
Se or SY.X	Standard deviation of the data about the regression line
Significant	Refers to the statistical significance of F, R or "t"
Sm	Maximum stress (psi)
Strain Rate	Crosshead speed divided by EGL
Sr	Stress at rupture (psi)
Standard Deviation (Sy or sd)	Square root of variance
"t" test	A statistical test used to detect significant differences between a measured parameter and an expected value of the parameter (determines if regression slope differs from zero at the 95% confidence level)
TCLE	Thermal Coefficient of Linear Expansion, the slope of the line above and below the glass point
TGA	Thermogravimetric Analyzer, determines mass loss of propellant when heated
Variance	The sum of squares of deviations of the test results from the mean of the series after division by one less than the total number of test results
$\bar{X}$	Mean of set of data

PROGRAM INTRODUCTION

PURPOSE: The purpose of this program is to continue surveillance testing of Minuteman Reentry System Launch Program Stage II propellant. This surveillance will elucidate the aging characteristics of the propellant and, using statistical trends derived from laboratory testing, will help to establish the service life expectancy of similar motors in the inventory.

BACKGROUND: Surveillance testing was initiated in 1963 on cartons of propellant cast from the same propellant used in motor manufacture.

In 1971, all laboratory prepared insulation material and case-to-propellant bond specimens were destroyed in a conditioning chamber malfunction. The number of cartons of propellant on hand were also near depletion, which would have terminated the OO-ALC Surveillance Program.

A force modernization program made available some older Minuteman II Stage II Motors. In 1973, three of these motors were selected to represent the motor inventory and were dissected for laboratory surveillance testing. The motors selected were S/N 0022135, cast date June 1963; S/N 0022583, cast date January 1964; and S/N 0022788, cast in July 1964. An additional motor, S/N 0022687, cast in April 1964, became available and was dissected in 1981 for continuing surveillance testing. The test data from Stage II dissected motors were assumed to have a normal population that could be combined. This was a fallacious assumption as shown in MANPA Report Nr. 496(84) where individual regressions were made for each motor with S/N 0022687 visually displayed on the multi-motor plots.

Motor S/N 0022687 was dissected by Aerojet in a different manner from other motors. The distance between cuts B and C, and cuts C and D was increased to 16 inches (Figures 1 and 2).

Segments A, B, and C from Section 2 of Motor S/N 0022687 were used for current testing. Figure 3 illustrates the cutting plan for the latest test period. The general test directive (GTD-2 Dissect Amendment 2, April 1984) specifies that test specimens be conditioned at controlled relative humidity. In the current test period, both conditioned and unconditioned specimens were tested. Other changes in that GTD were different test temperatures for stress relaxation, deletion of some testing, and addition of mini-thin tensile specimens from the bore area.

Motors which have been dissected to date are:

MOTOR S/N	CAST DATE	UNCONDITIONED	CONDITIONED
0022135	63162	□	
0022123	63163	◇	◇
0022583	64008	○	⊛
0022687	64096	✱	
0022788	64197	△	

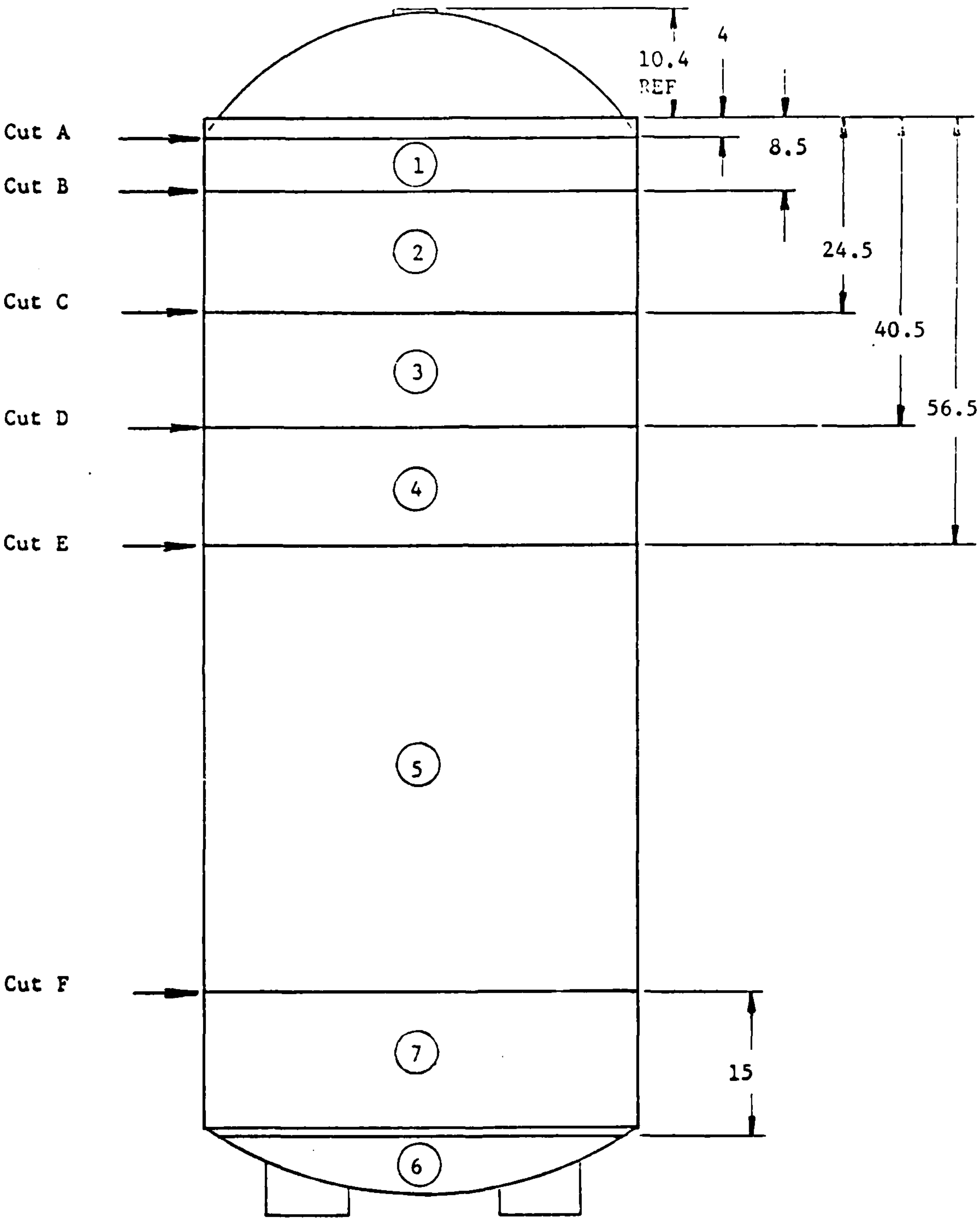


Figure 1 Dissection layout of Cuts, Locations and Section Numbers

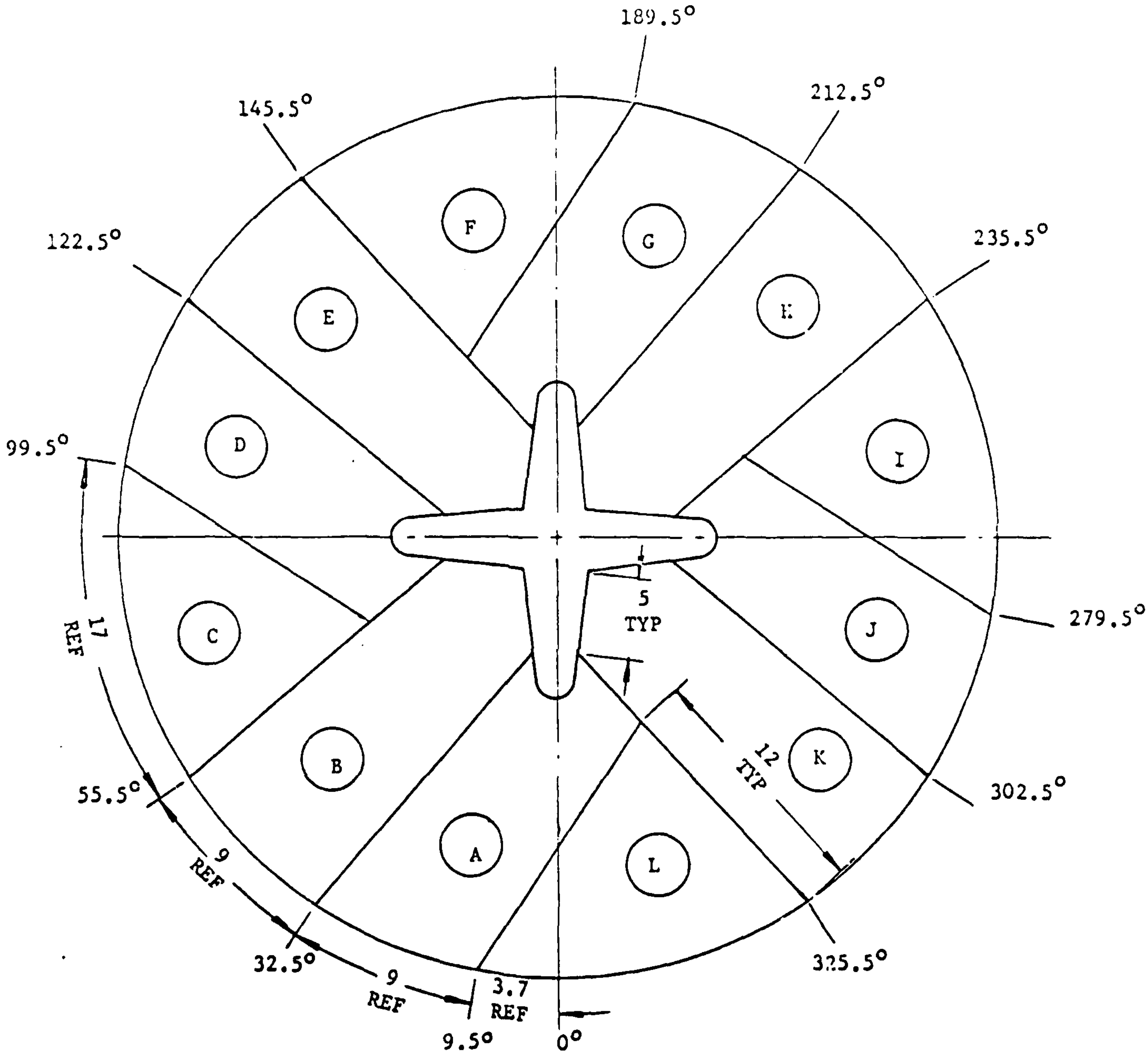


Figure 2 Section 3 and 4 Segment Layout and Letter Identification

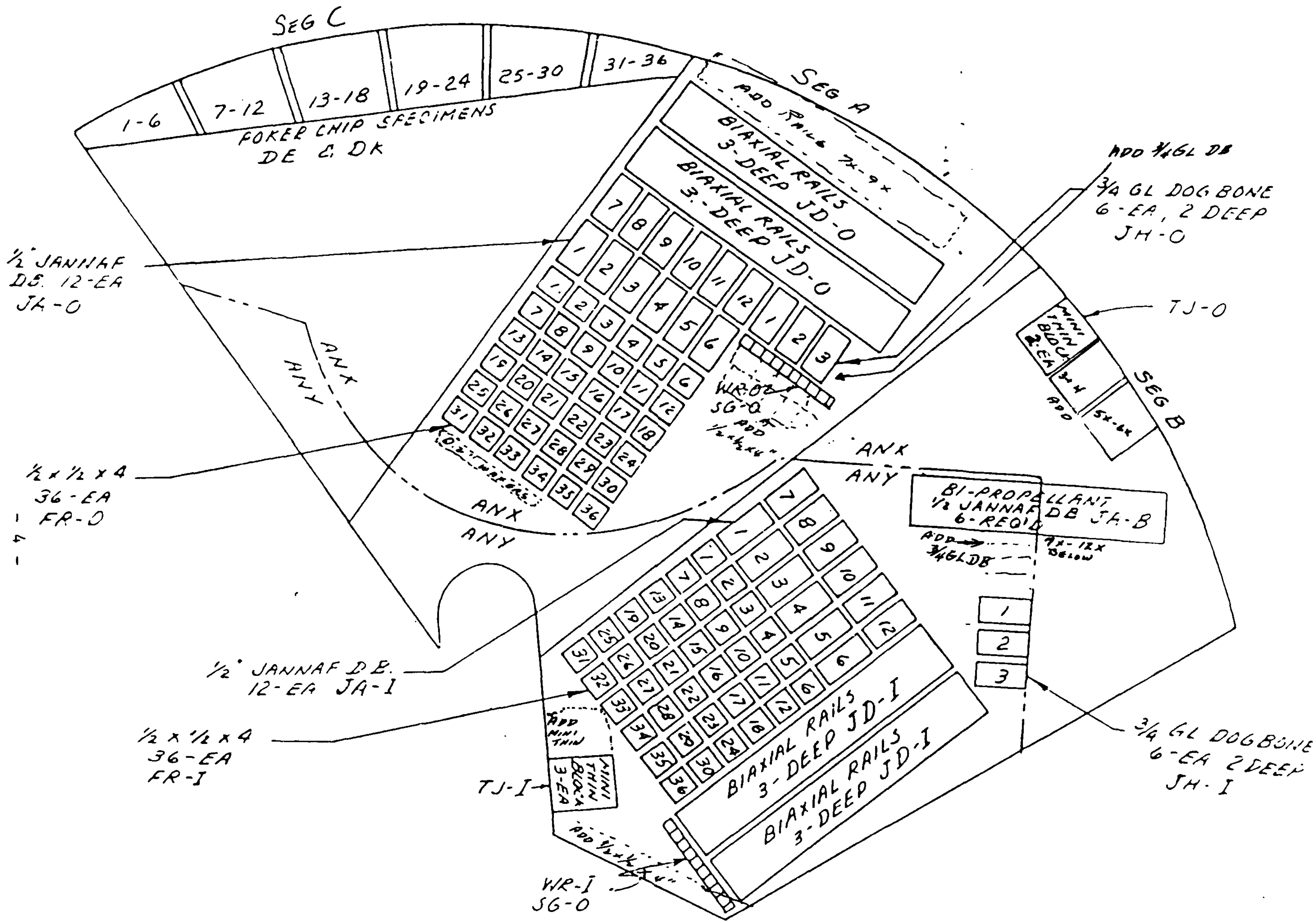


FIGURE 3: LGM-30 STAGE 2 DISSECTED MOTOR CUTTING PLAN

TEST RESULTS

INTRODUCTION:

Testing in 1986 represented the fourth test period for Motor S/N 0022687. Specimens for conditioned testing were taken from those areas shown in Figure 3 MAQCP Report 514 (86). Additional specimens for unconditioned testing were taken as indicated in Figure 3 this report.

It was not feasible to obtain similar numbers of specimens and some orientations were different for the unconditioned specimens. For a number of reasons, conditioned specimens were not tested on schedule. The prolonged conditioning introduced another variable into the testing and the resulting data show unexpected values. Moreover, effects are not consistent from test to test. In this report current results are overlaid manually on last year's plots. The multi-motor plots are not statistically valid since the motors are not combinable. The information in the figures is for visual reference. In some cases, usually for outer propellant, there are additional figures and all tensile parameters are given. Inner propellant has been limited in most instances to three parameters, as in the previous report.

Data tables are given, frequently with means and standard deviation. There are no sample size summaries.

A. UNIAXIAL TENSILE TESTS:

1. VERY LOW RATE (CHS 0.0002 in/min CHS). Data are shown in Table 1.

a. Outer conditioned propellant shows a decrease in maximum stress and strain at rupture with a minimal increase in modulus compared to last year's testing. Unconditioned specimens were tested at 2 x 10^{-3} in/min in error, so data have not been plotted. Figures 4, 5, and 6 show the disparity between conditioned and unconditioned specimens.

b. Inner conditioned propellant shows that maximum stress (Figure 7), and modulus values (Figure 9) are the lowest of all four test periods. Strain at rupture (Figure 8) is lower than at last test period, but greater than both sets of unconditioned data.

c. Bipropellant shows lower values for all three parameters, but the magnitude of differences in means between the last two test periods varies (Figures 10, 11, and 12).

2. LOW RATE TENSILE (CHS 2 in/min). Data are shown in Table 2.

a. Outer propellant (conditioned) shows a markedly lower values than last year's. These are the lowest of all four test periods (Figures 13 thru 17).

b. Inner propellant which has been conditioned shows lower maximum stress and modulus than last year and lower than unconditioned propellant (Figures 15 and 17). On the other hand, strain at rupture is higher and is closer to being the same value (0.7817 vs 0.7847) for both unconditioned and conditioned (Figure 16).

B. BIAXIAL TENSILE TEST (CHS 0.2 in/min). Data are shown in Table 3.

1. Outer unconditioned propellant is much closer to other unconditioned propellant than to conditioned propellant for this test period. The differences in the two test periods for conditioned propellant are very great. Except for modulus (Figure 22), last year's values are higher than this year's (Figures 18 thru 21).

2. The difference between 1985 and 1986 test values for inner propellant are not nearly so large as for outer propellant. Unconditioned values for stresses and strains seem to form a pattern into which last year's conditioned values fit (Figures 24 thru 29). Modulus for 1986 is lower for both unconditioned and conditioned specimens (Figures 30).

C. HIGH RATE HYDROSTATIC TENSILE (CHS 1750 in/min, 500 psi). Data are shown in Table 4.

1. The stresses for outer propellant show a decrease from previous testing with a greater decrease for conditioned specimens (Figures 31 and 33). The difference between conditioned specimens is even larger for strains. Unconditioned specimens seem to follow a pattern for strains (Figures 32 and 34). Modulus is slightly above last year's values (Figure 35).

2. Maximum stress for inner propellant repeats the pattern for outer propellant (Figure 36). Strain at rupture is higher this time than at the last test period Figure 37). Modulus appears to be of the same magnitude for three test periods Figure 38).

D. MINITHIN TENSILE (0.1" slices, 1 in/min CHS). Data are given in Table 5.
A comparison was made of the data obtained by testing both by slice and block. No consistent pattern emerges when the blocks are compared, nor is there a pattern for slices. For example, outer conditioned propellant, strain at rupture, slice 6, shows a maximum for block 1 and a minimum for blocks 3 and 4 Unconditioned blocks for the same parameter at the same slice also shows a minimum and maximum (Figure 39).

1. Outer propellant comparisons are shown in Figures 39 thru 43. Both slice-to-slice and block-to-block variations are shown on one figure. It is apparent from strain at rupture comparisons (Figure 42) that slice 1 shows the greatest range of values. Figures 44 thru 48 compare conditioned propellant,and Figures 49 thru 53 compare unconditioned propellant.

2. Inner propellant is shown in Figures 54 thru 58. There does not appear to be any consistency either in blocks or slices (Figures 59 thru 68).

E. STRESS RELAXATION (3% strain). Data are given in Table 6.
Master stress relaxation curves are shown in Figures 69 and 70. These curves are very similar to those generated with 1985 data, and data for inner and outer propellant almost overlay each other.

1. Outer propellant unconditioned values are higher than for conditioned propellant (Figures 71 thru 74). Conditioned propellant has lower moduli than in 1985, although the difference approximates that shown in the first two test periods.

2. Inner propellant shows lower values for conditioned propellant than in 1985. Unconditioned propellant may be higher or lower than conditioned propellant for the current test period (Figures 75 thru 78).

F. THERMAL COEFFICIENT OF LINEAR EXPANSION (TCLE). Data are in Table 7.
Glass points for both outer and inner propellant are very close to each other at this test period, (outer -56.8°C vs inner -57.0°C). However, the slopes of each run both below and above the glass point are so different from prior data that no plots have been included. New equipment should be available for the next test period, which may resolve these differences.

G. HARDNESS. Data are shown in Table 8.
Conditioning normally softens propellant. Surprisingly, the Shore A 10 second readings for conditioned propellant are higher than for unconditioned propellant.

1. Outer propellant, as shown in Figure 80, has a conditioned reading which is close to 1985's unconditioned. The unconditioned 1986 is slightly lower than 1985's conditioned.

2. Inner propellant, as shown in Figure 81, has a conditioned value very near that of previous testing's conditioned value. The unconditioned 1986 value does not fall in line with prior unconditioned data.

H. BOND PROPERTIES. Data are shown in Table 9.
Tensile testing was unsatisfactory with many bond failures. The constant load test produced slightly lower values than 1985 testing. There were many failures within the propellant or at the propellant liner interface and very little cohesive failure within the liner.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS:

The effects of humidity on propellant cannot be precisely evaluated since other variables which are related to the length of conditioning entered the situation. Some equipment was not operational at the required time of testing. As a result, specimens remained in conditioning as long as three months.

It was not feasible to obtain specimens for unconditioned testing for all tests. No statistical comparisons were made. Graphically, there is a considerable difference between the relationship of the conditioned specimens to other test periods. There is fair to excellent agreement depending upon the parameter between conditioned and unconditioned specimens at this test period. Stress relaxation modulus for both inner and outer propellant shows a much greater similarity between conditioned and unconditioned propellant than other tests. The fact that stress relaxation modulus did not show large changes when the propellant was exposed to varying degrees of humidity was the driver for the addition of the humidity requirement to the test program.

RECOMMENDATIONS:

Testing of both conditioned and unconditioned specimens for one more test period is needed to provide sufficient data for statistics. At that time there would be four unconditioned points and three conditioned points. These would provide sufficient information for some statistical conclusions. Therefore, it is strongly recommended that another test program be initiated as soon as possible.

TABLE 1

MOTOR 0022687
VERY LOW RATE TENSILE
0.0002 IN/MIN

CONDITIONED ANX (OUTER)

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	32.7	.245	29.8	.276	202
	36.0	.241	34.9	.251	224
	36.8	.193	35.4	.228	235
	37.4	.197	36.6	.221	239
	38.8	.195	37.4	.227	248
	41.2	.193	38.8	.211	264
X=	37.15	.2107	35.48	.2357	235.3
SD=	2.844	.02512	3.117	.02375	21.41

ANY (INNER)

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	46.5	.375	42.5	.455	184
	45.0	.333	43.4	.363	185
	43.1	.337	36.7	.432	174
	43.4	.339	37.5	.428	174
	43.4	.341	40.8	.393	170
	43.2	.344	36.2	.484	168
X=	44.10	.3448	39.52	.4258	175.8
SD=	1.368	.01524	3.119	.04313	7.11

ANC (BIPROPELLANT)

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	34.5	.217	34.1	.217	193
	34.7	.217	34.4	.219	194
	34.9	.223	34.7	.234	193
	33.9	.216	33.4	.218	199
	34.4	.225	34.2	.228	189
	35.1	.231	34.4	.233	195
X=	34.58	.2215	34.20	.2248	193.8
SD=	.422	.00592	.443	.00778	2.97

TABLE 1 (CONT'D)

MOTOR 0022687
VERY LOW RATE TENSILE
0.002 IN/MIN

UNCONDITIONED ANC

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	47.6	.246	46.6	.251	255
	45.9	.255	44.8	.259	263
	45.7	.250	44.8	.254	246
	44.1	.259	43.3	.263	259
	43.5	.250	42.7	.275	253
	42.9	.314	41.3	.318	203
X=	44.95	.2623	43.92	.2700	246.5
SD=	1.761	.02571	1.869	.02496	22.07

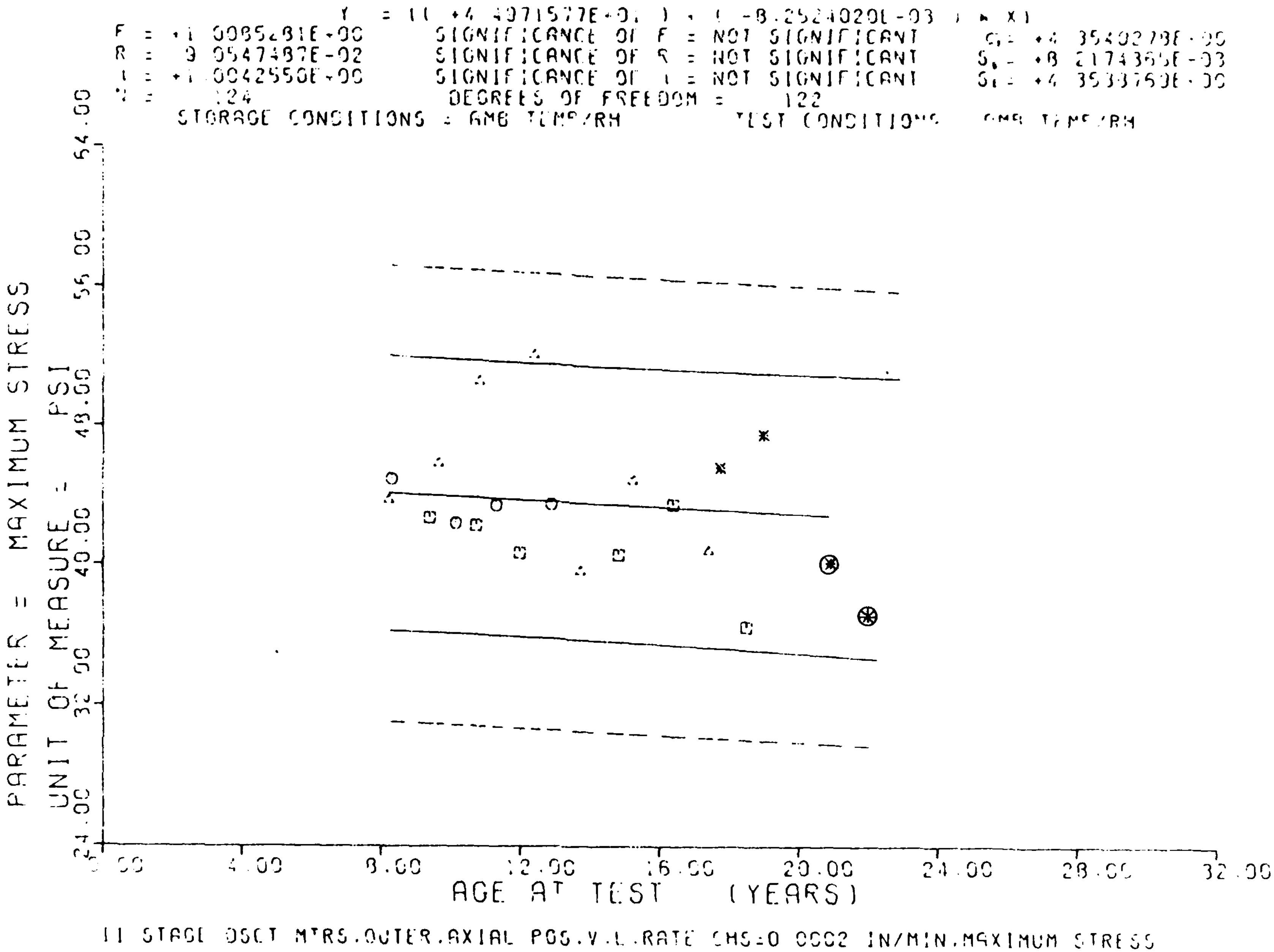

Y = ((+4.4971577E+01) + (-8.2524020E-03) * X)
F = +1.0085481E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT S_Y = +4.3540278E+00
R = 9.0547487E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +8.2174365E-03
t = +1.0042550E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT S_E = +4.3533750E+00
N = 124 DEGREES OF FREEDOM = 122
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS AMB TEMP/RH
PARAMETER = MAXIMUM STRESS
UNIT OF MEASURE = PSI
24.00
32.00
40.00
48.00
56.00
64.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
II STAGE DSCT MTRS.OUTER.AXIAL POS.V.L.RATE CHS=0.0002 IN/MIN.MAXIMUM STRESS

FIGURE 4

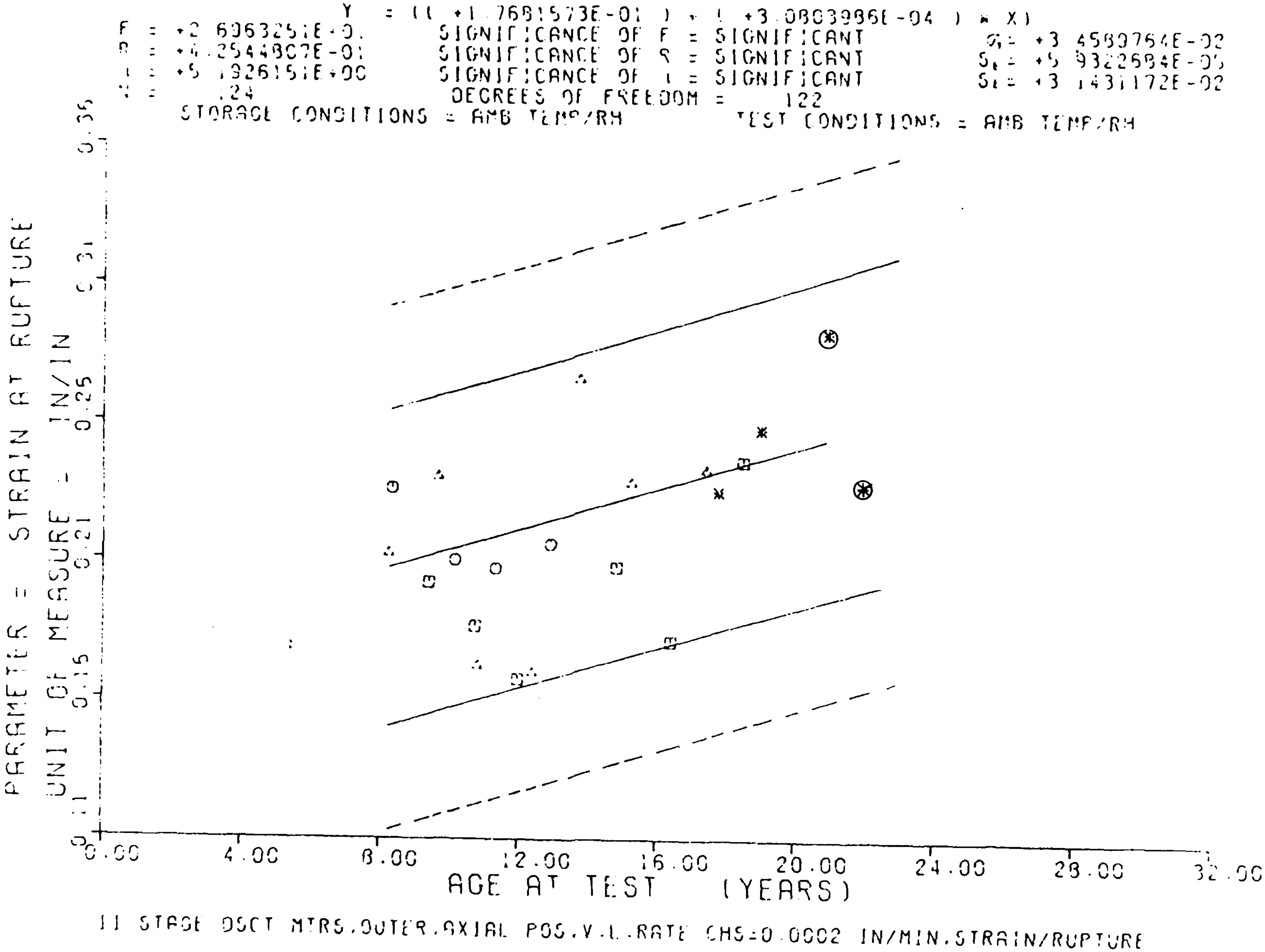

Y = ((+1.7681573E-01) + (+3.0803986E-04) * X)
F = +2.6963251E+01
R = +4.2544807E-01
T = +5.1926151E+00
N = 124
SIGNIFICANCE OF F = SIGNIFICANT
SIGNIFICANCE OF R = SIGNIFICANT
SIGNIFICANCE OF T = SIGNIFICANT
DEGREES OF FREEDOM = 122
STORAGE CONDITIONS = AMB TEMP/RH
TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
0.11
0.15
0.21
0.25
0.31
0.35
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
II STAGE DSCT MTRS,OUTER,AXIAL POS.V.L.RATE CHS=0.0002 IN/MIN.STRAIN/RUPTURE

FIGURE 5

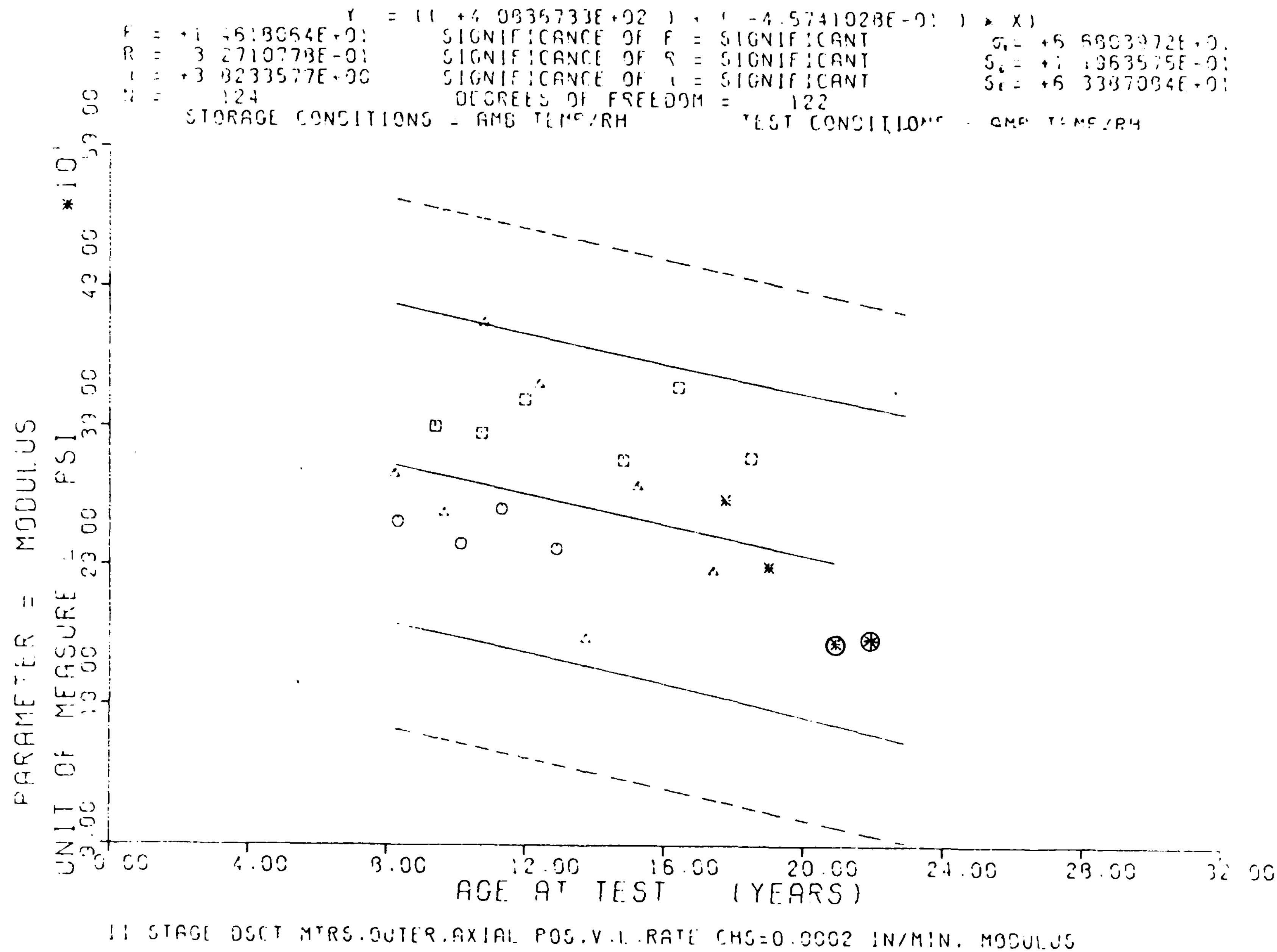
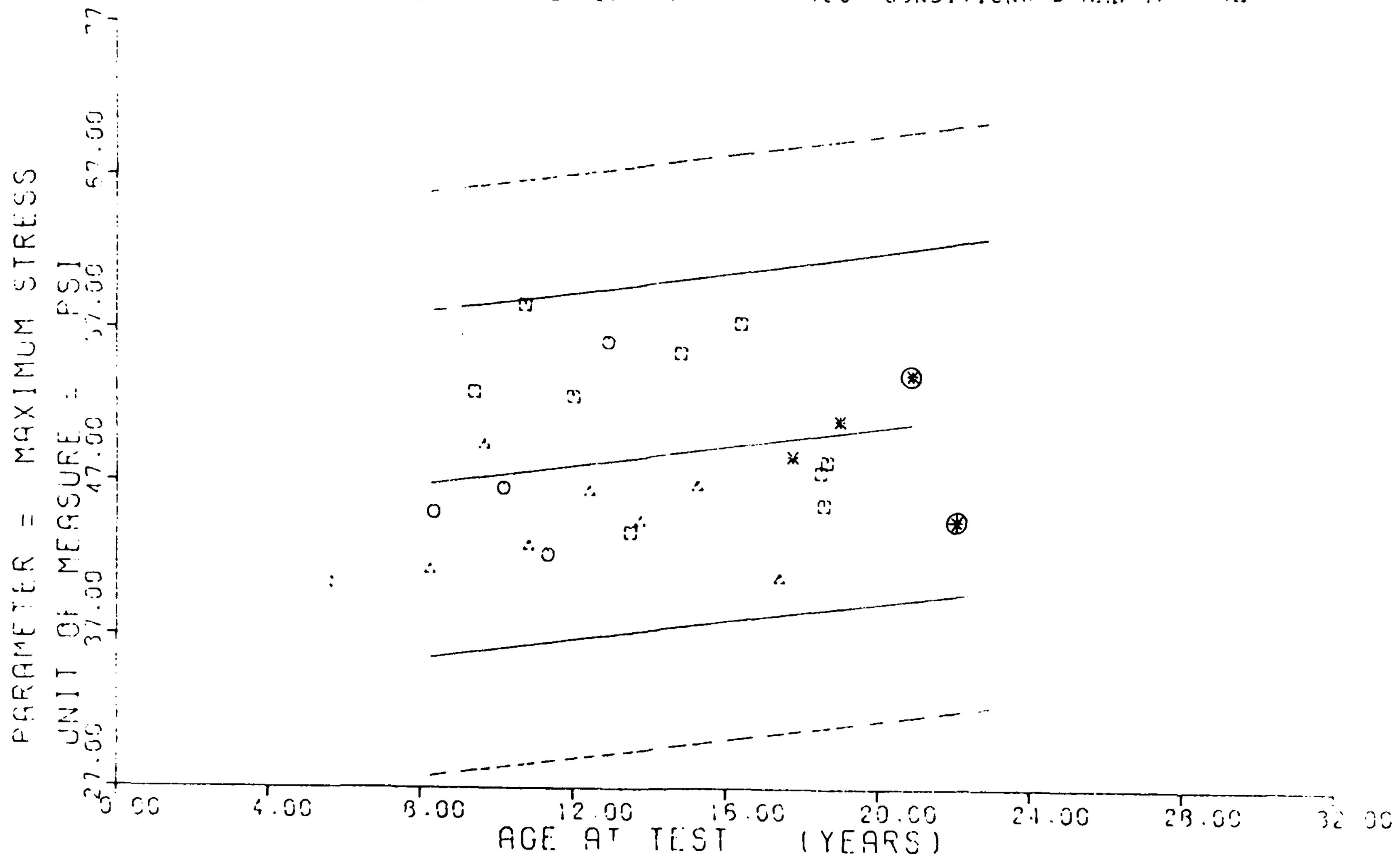

Y = ((+4.0836733E+02) + (-4.5741028E-01) * X)
F = +1.4618064E+01 SIGNIFICANCE OF F = SIGNIFICANT
R = 3.2710778E-01 SIGNIFICANCE OF R = SIGNIFICANT
t = +3.8233577E+00 SIGNIFICANCE OF t = SIGNIFICANT
N = 124 DEGREES OF FREEDOM = 122
STORAGE CONDITIONS - AMB TEMP/RH
TEST CONDITIONS - AMB TEMP/RH
PARAMETER = MODULUS
UNIT OF MEASURE = PSI
*10
AGE AT TEST (YEARS)
II STAGE DSCT MTRS.OUTER.AXIAL POS.V.L.RATE CHS=0.0002 IN/MIN. MODULUS

FIGURE 6

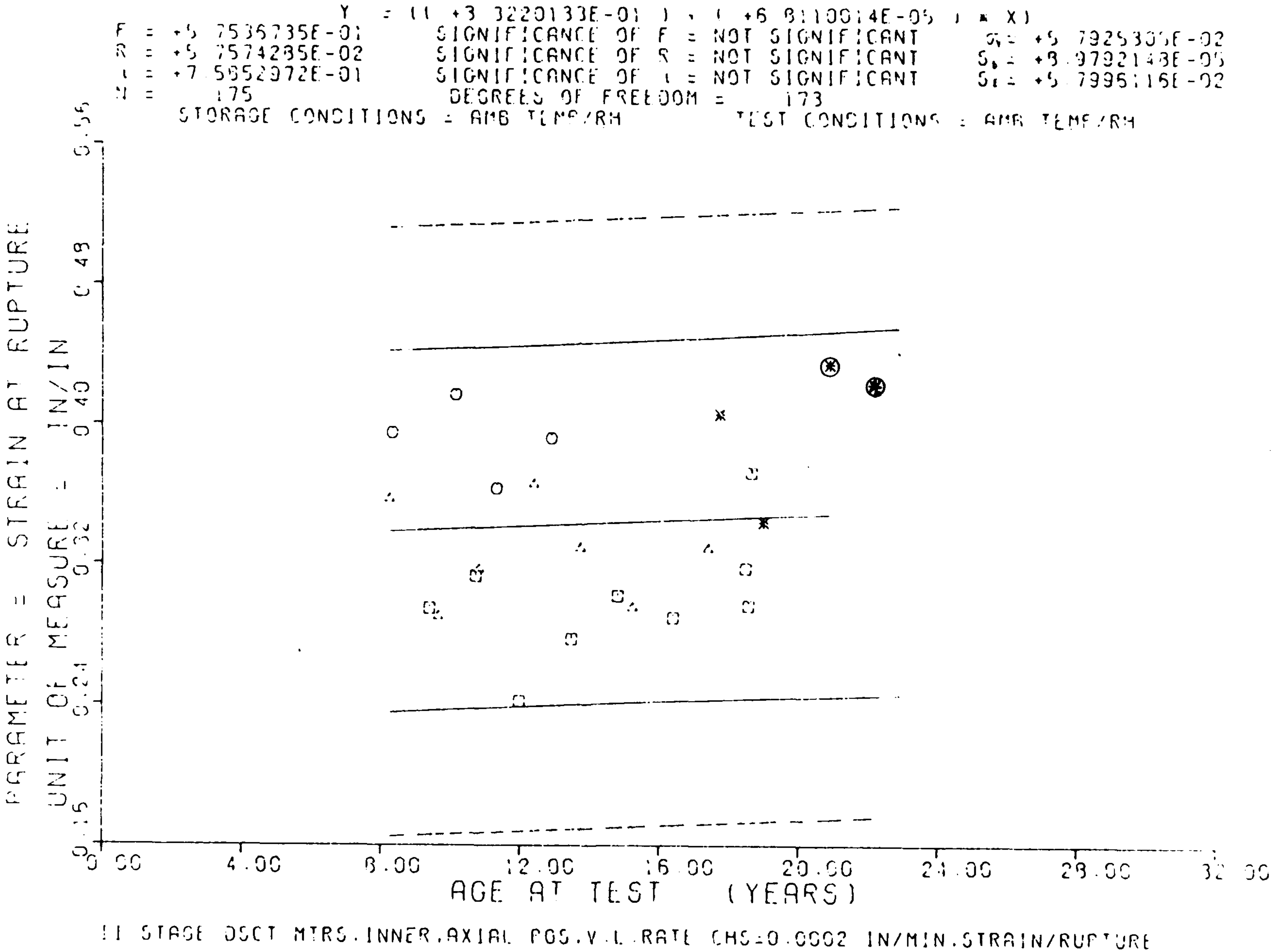
Y = ((+4.4292216E+01) + (+2.5054093E-02) * X)

F = +6.9921733E+00   SIGNIFICANCE OF F = SIGNIFICANT   σ = +6.4630048E+00
R = +1.9507306E-01   SIGNIFICANCE OF R = SIGNIFICANT   S = +9.8409357E-03
t = +2.6271987E+00   SIGNIFICANCE OF t = SIGNIFICANT   S = +6.3561911E+00
% = .75   DEGREES OF FREEDOM = 173
STORAGE CONDITIONS = AMB TEMP/RH   TEST CONDITIONS = AMB TEMP/RH



II STAGE OSCT MTRS.INNER.AXIAL POS.V.L.RATE CHS=0.0002 IN/MIN.MAXIMUM STRESS

FIGURE 7


Y = ((+3 3220133E-01) + (+6 8110014E-05) * X)
F = +5 7536735E-01
R = +5 7574285E-02
t = +7 5552972E-01
N = 175
SIGNIFICANCE OF F = NOT SIGNIFICANT
SIGNIFICANCE OF R = NOT SIGNIFICANT
SIGNIFICANCE OF t = NOT SIGNIFICANT
DEGREES OF FREEDOM = 173
STORAGE CONDITIONS = AMB TEMP/RH
TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
0.15
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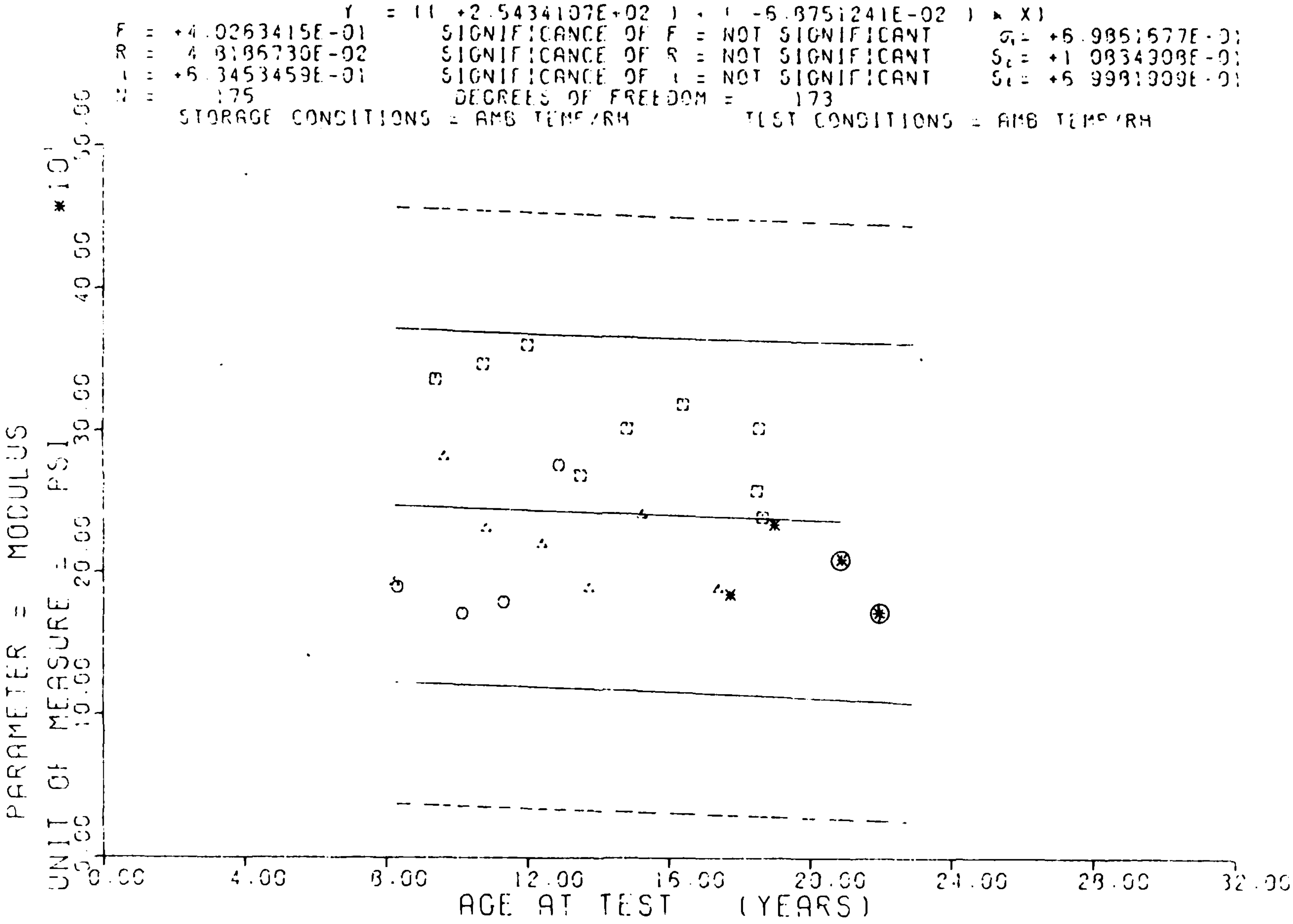
0.32
0.40
0.48
0.56
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
II STAGE DSCT MTRS.INNER.AXIAL POS.V.L.RATE CHS=0.0002 IN/MIN.STRAIN/RUPTURE

FIGURE 8

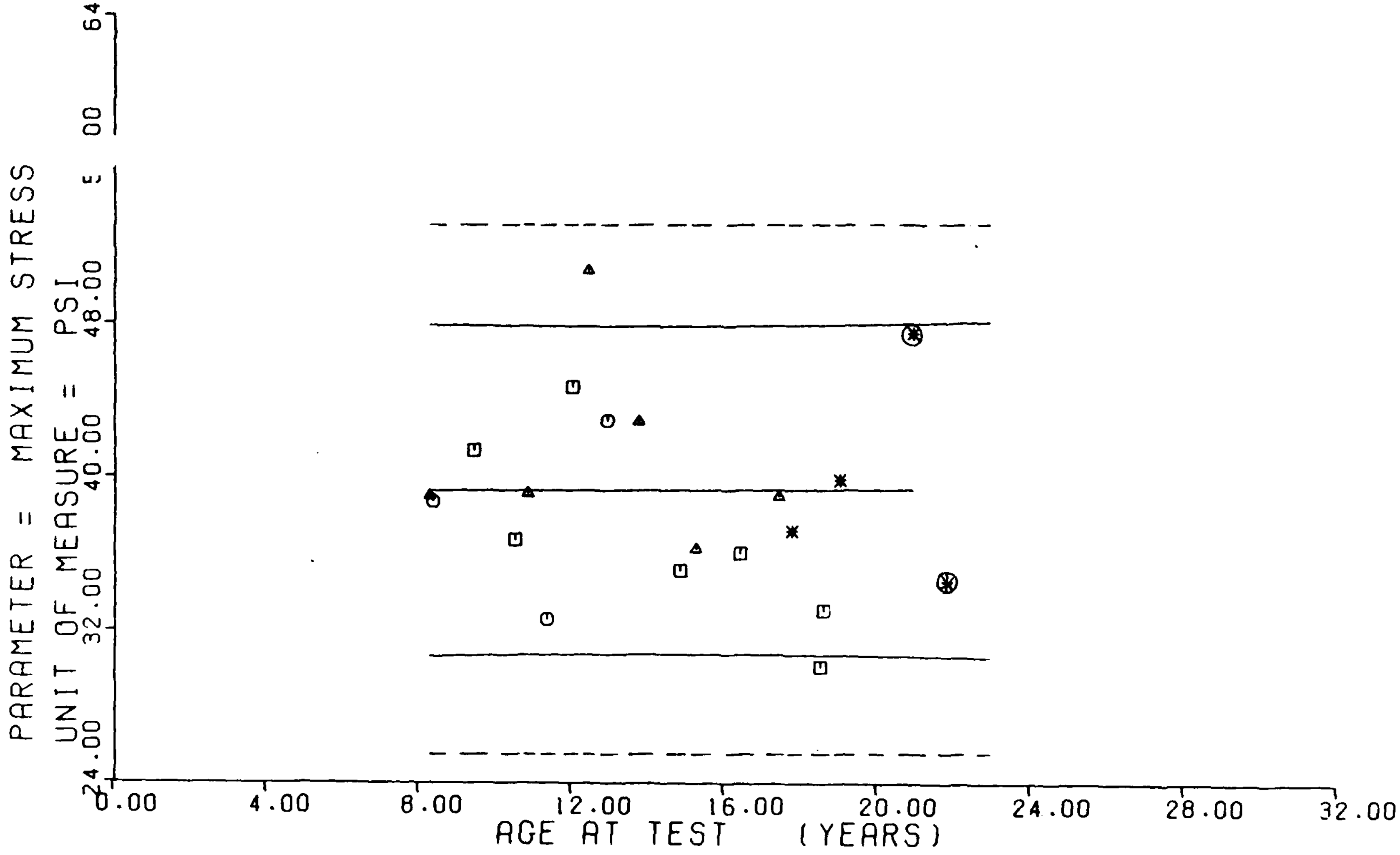


II STAGE DSCT M'RS.INNER.AXIAL POS.V.L.RATE CHS=0.0002 IN/MIN. MODULUS

FIGURE 9

Y = ((+3.9226130E+01) + (+5.8239123E-04) * X)

F = +3.6403120E-03   SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +4.5717577E+00
R = +6.7880613E-03   SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +9.6526269E-03
ι = +6.0334998E-02   SIGNIFICANCE OF ι = NOT SIGNIFICANT S_E = +4.6004959E+00
N = 81   DEGREES OF FREEDOM = 79
STORAGE CONDITIONS = AMB TEMP/RH   TEST CONDITIONS = T/TEMP=077 DEG(F



II STAGE DSCT MTR.   BI-PROP,CHS=.0002 IN/MIN,T/TEMP=077DEG(F),MAX STRES

FIGURE 10

Y = ((+2.1254117E-01) + (+1.5374973E-04) * X)

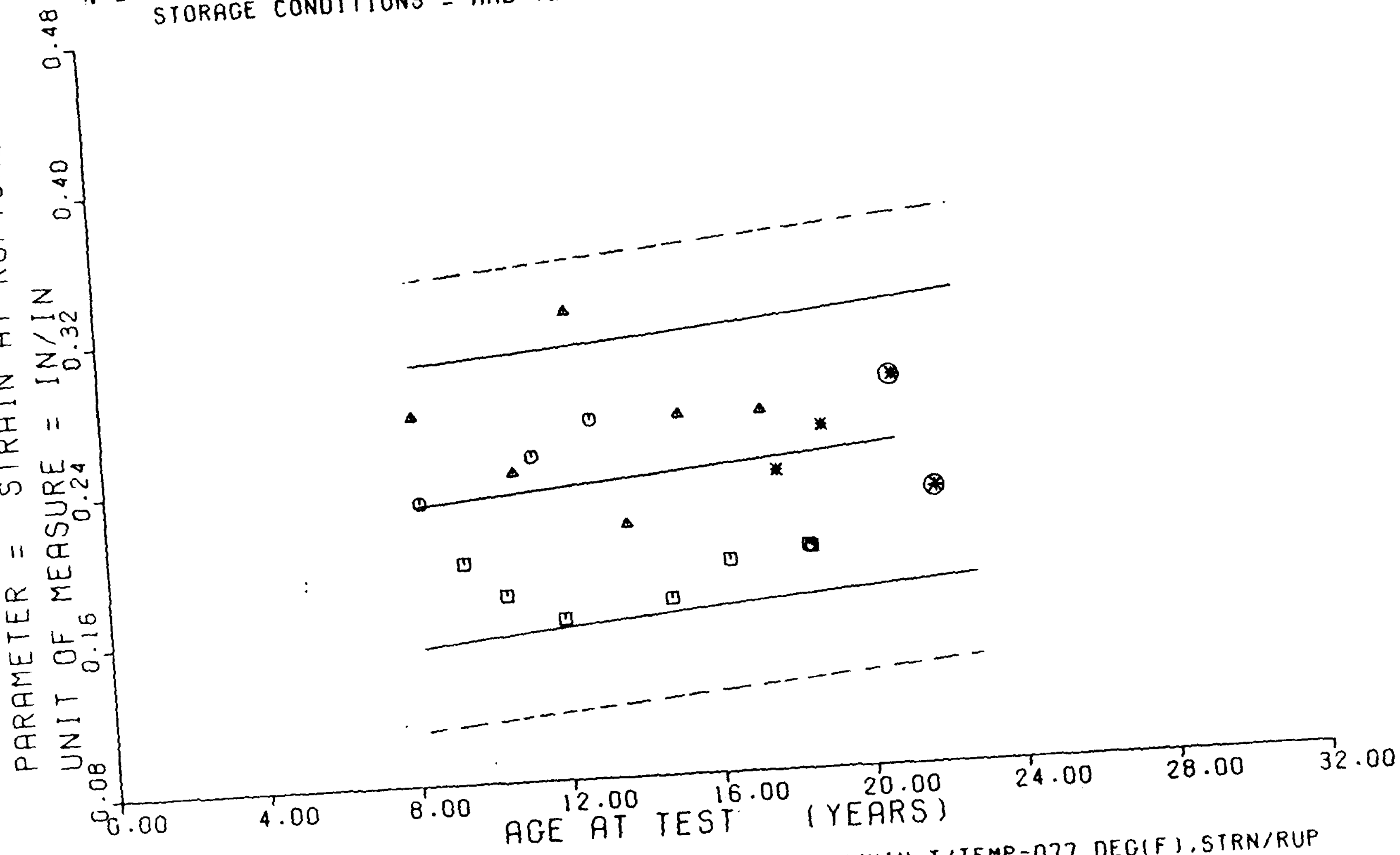
F = +3.4309256E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +4.0157618E-02

R = +2.0401428E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +8.3005853E-05

t = +1.8522758E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT S_E = +3.9561053E-02

N = 81 DEGREES OF FREEDOM = 79

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = T/TEMP=077 DEG(F



II STAGE DSCT MTR. 81-PROP,CHS=.0002 IN/MIN,T/TEMP=077 DEG(F),STRN/RUP

FIGURE 11

Y = ((+3.0620985E+02) + (-2.7320822E-01) * X)

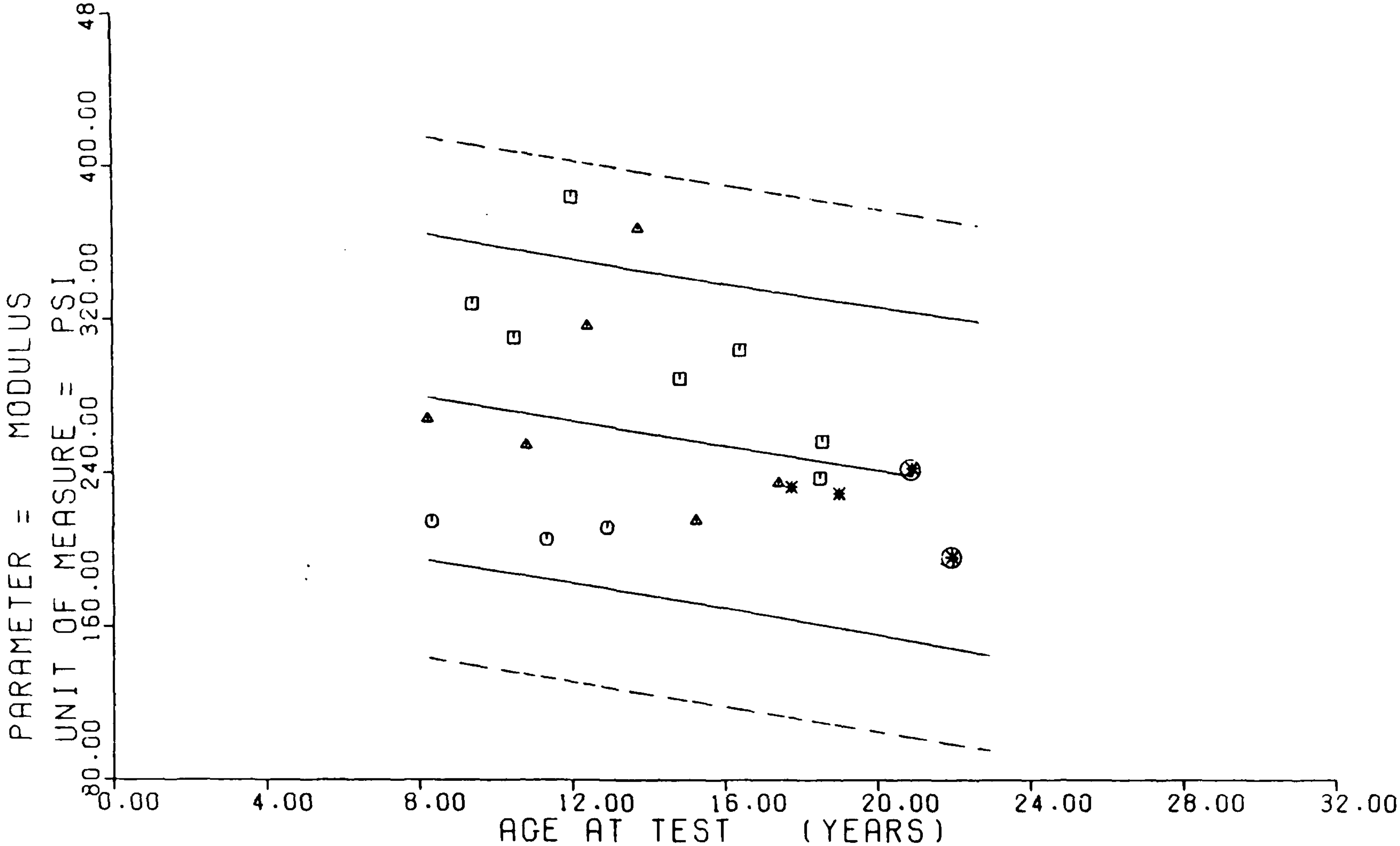
F = +8.3097600E+00 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +4.7189465E+01

R = -3.0850545E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +9.4776250E-02

t = +2.8826654E+00 SIGNIFICANCE OF t = SIGNIFICANT S_E = +4.5170890E+01

N = 81 DEGREES OF FREEDOM = 79

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS - T/TEMP-077 DEG(F



II STAGE OSCT MTR, BI-PROP,CHS=.0002 IN/MIN,T/TEMP=077 DEG(F),MODULUS

FIGURE 12

TABLE 2

MOTOR 00226877
LOW RATE TENSILE
77,2.0 IN/MIN,3.0 EGL

CONDITIONED ANX (OUTER)

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	74.7	.291	47.7	.651	575
	81.1	.282	44.4	.711	602
	82.8	.272	51.1	.627	665
	83.6	.269	57.8	.552	632
	84.8	.266	52.5	.590	705
	86.5	.267	55.3	.573	695
X=	82.25	.2745	51.47	.6173	645.7
SD=	4.123	.00993	4.902	.05828	51.80

UNCONDITIONED ANY (INNER)

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	129.0	.596	115.3	.802	738
	126.4	.597	114.6	.768	724
	124.2	.593	115.6	.752	660
	122.3	.589	112.6	.725	692
	121.6	.601	108.7	.816	643
	125.7	.628	112.7	.827	638
X=	124.7	.6007	113.25	.7817	682.5
SD=	7.4350	.01398	2.568	.0398	42.28

CONDITIONED ANY (INNER)

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	96.3	.480	81.0	.765	540
	94.4	.411	72.8	.765	600
	92.2	.411	78.5	.664	555
	90.5	.415	67.0	.803	575
	89.6	.420	63.4	.871	613
	89.4	.421	64.6	.840	596
X=	92.07	.4263	71.22	.7847	579.8
SD=	2.794	.0266	7.402	.07237	28.266

Y = ((+1.0706140E+02) + (+2.4035422E-02) * X)

F = +9.7206837E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +1.6673228E+01

R = +8.2456103E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +2.4378296E-02

ι = +9.8593528E-01 SIGNIFICANCE OF ι = NOT SIGNIFICANT S_ε = +1.6674857E+01

N = 144 DEGREES OF FREEDOM = 142

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH

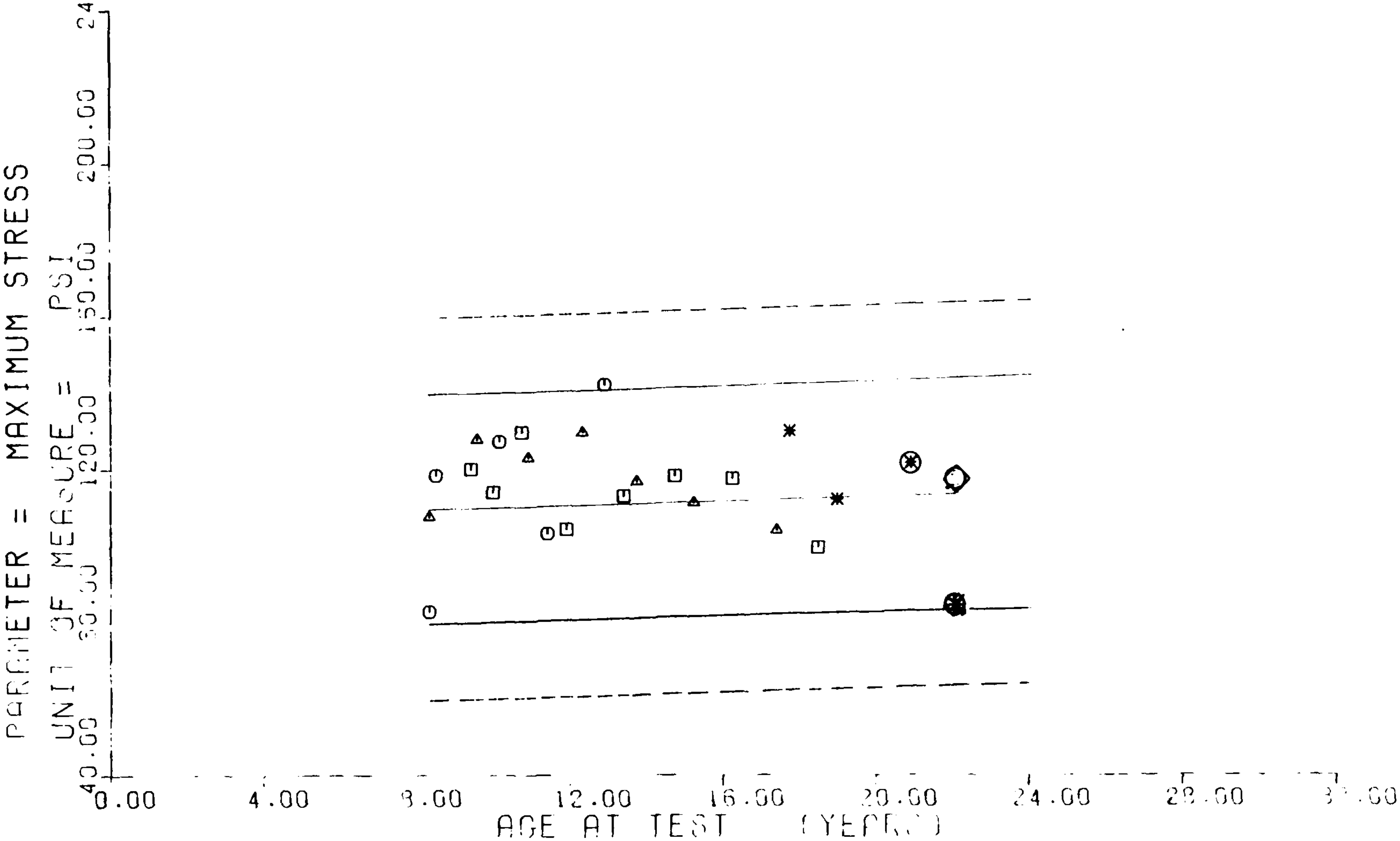
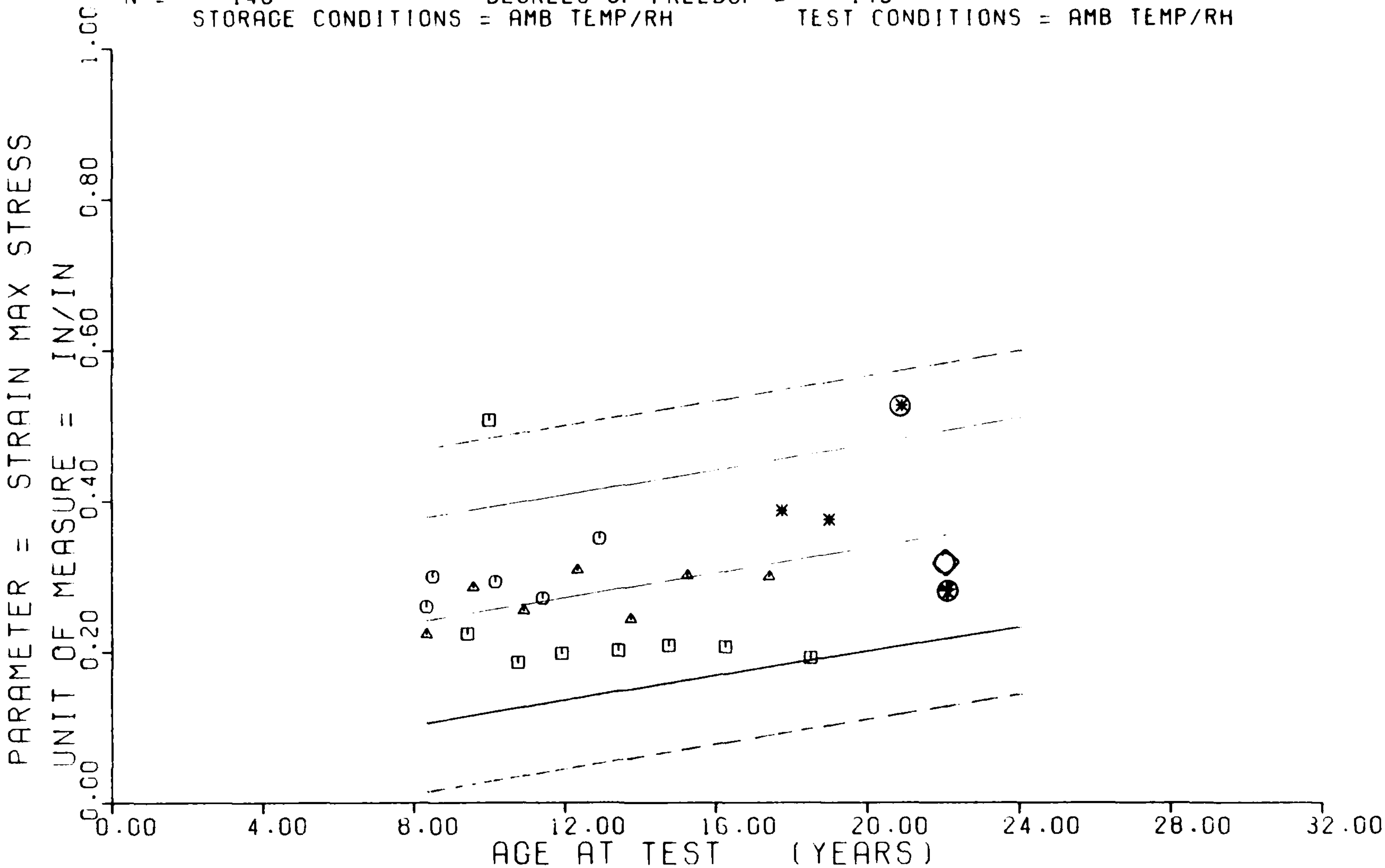


FIGURE 13

Y = ((+1.7308903E-01) + (+6.8775739E-04) * X)

F = +3.8521757E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_r = +8.5149678E-02
R = +4.6066869E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +1.1081083E-04
t = +6.2065898E+00 SIGNIFICANCE OF t = SIGNIFICANT S_ε = +7.5840277E-02
N = 145 DEGREES OF FREEDOM = 143

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



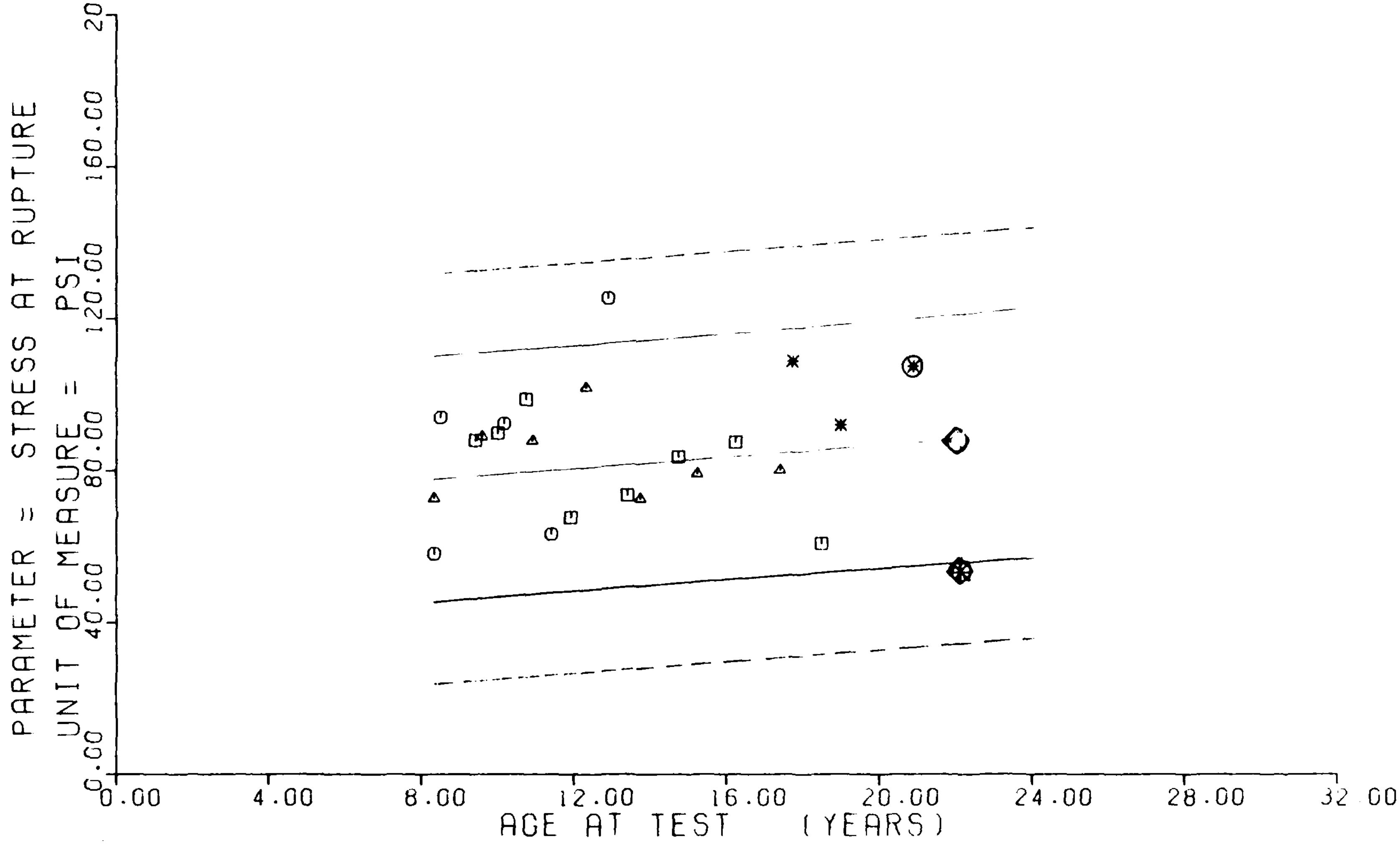
II STAGE DSCT MTRS ONLY, OUTER,AXIAL POS,LOW RATE CHS=2.0 IN/MIN,STRN MAX STRS.

FIGURE 14

Y = ((+7.1301130E+01) + (+6.3989308E-02) * X)

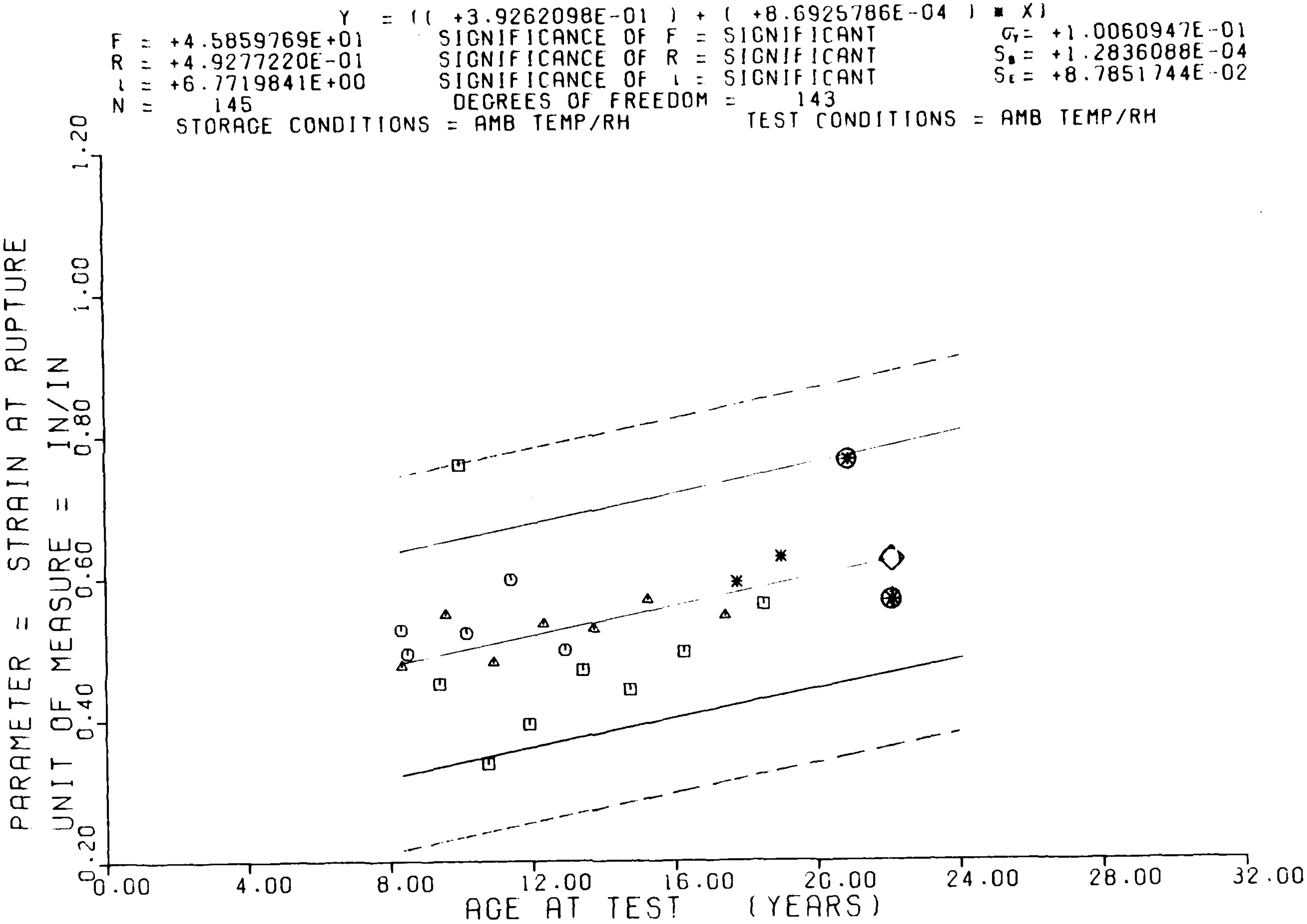
F = +5.9255888E+00 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +1.8296278E+01
R = +1.9947161E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +2.6287038E-02
t = +2.4342532E+00 SIGNIFICANCE OF t = SIGNIFICANT S_E = +1.7991167E+01
N = 145 DEGREES OF FREEDOM = 143

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



II STAGE DSCT MTRS ONLY, OUTER,AXIAL POS.LOW RATE CHS=2.0 IN/MIN,STRESS/RUPTURE

FIGURE 15



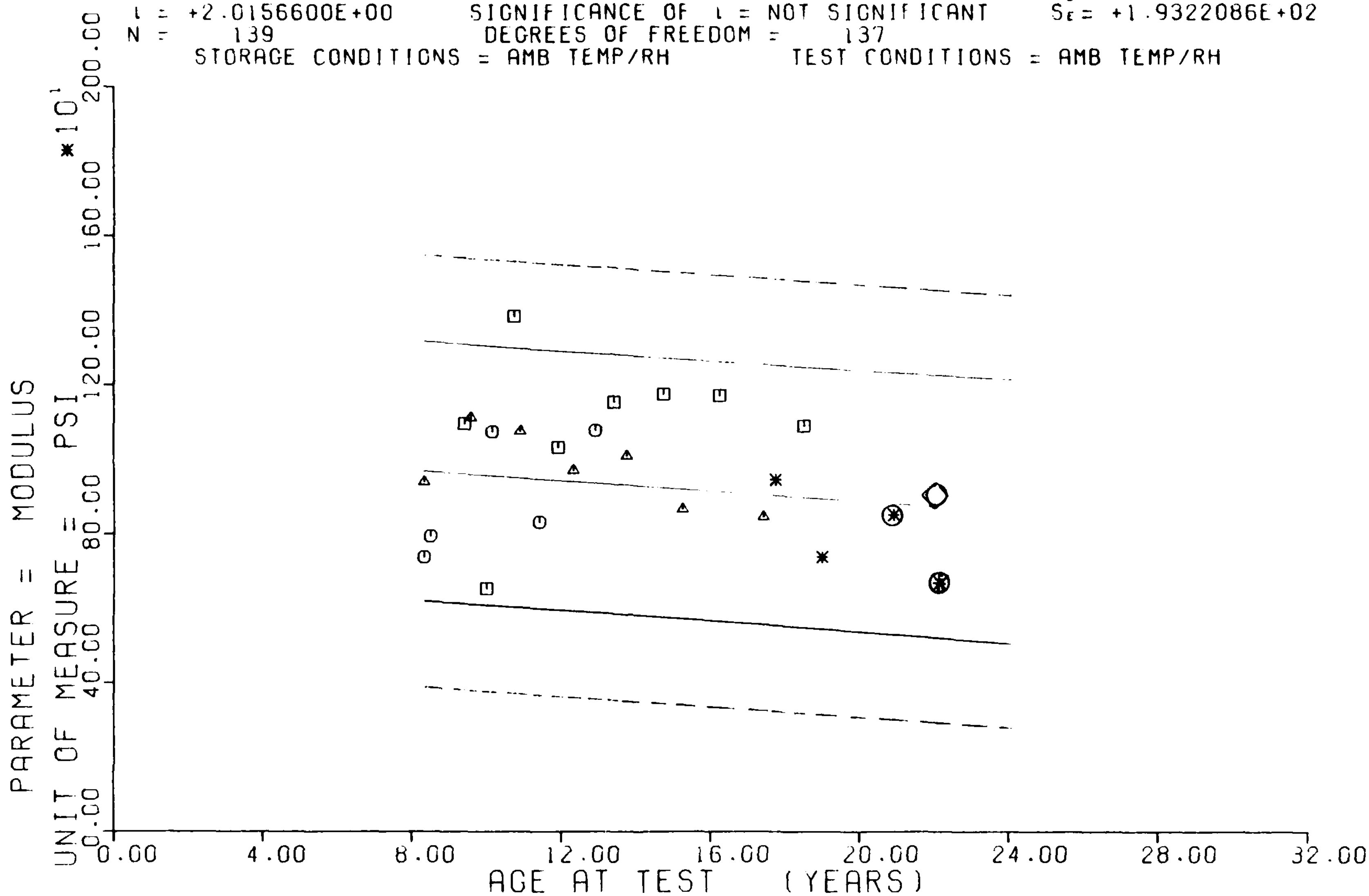
II STAGE OSCT MTRS ONLY, OUTER,AXIAL POS.LOW RATE CHS=2.0 IN/MIN,STRAIN/RUPTURE

FIGURE 16

Y = ((+1.0250945E+03) + (-5.7778738E-01) * X)

F = +4.0628852E+00 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +1.9535335E+02
R = -1.6971135E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +2.8664923E-01
t = +2.0156600E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT S_E = +1.9322086E+02
N = 139 DEGREES OF FREEDOM = 137

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



II STAGE DSCT MTRS ONLY, OUTER,AXIAL POS.LOW RATE CHS=2.0 IN/MIN, MODULUS

FIGURE 17

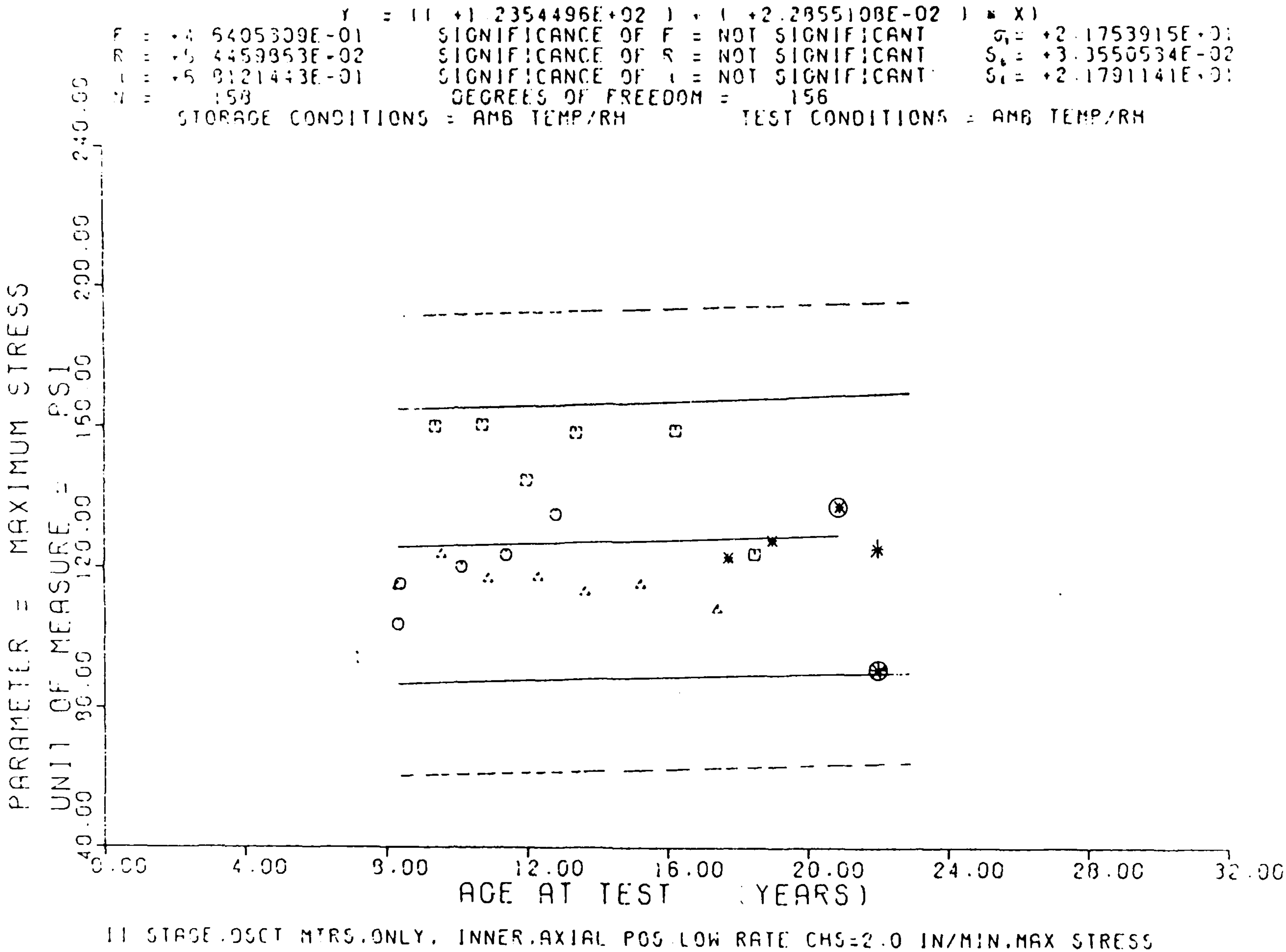

Y = ((+1.2354496E+02) + (+2.2855108E-02) * X)
F = +4.6405309E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT σ = +2.1753915E+01
R = +5.4459853E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S = +3.3550534E-02
t = +6.8121443E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT S = +2.1791141E+01
N = 158 DEGREES OF FREEDOM = 156
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = MAXIMUM STRESS
UNIT OF MEASURE = PSI
240.00
200.00
160.00
120.00
80.00
40.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
II STAGE.OSCT MTRS.ONLY, INNER.AXIAL POS LOW RATE CHS=2.0 IN/MIN.MAX STRESS

FIGURE 18

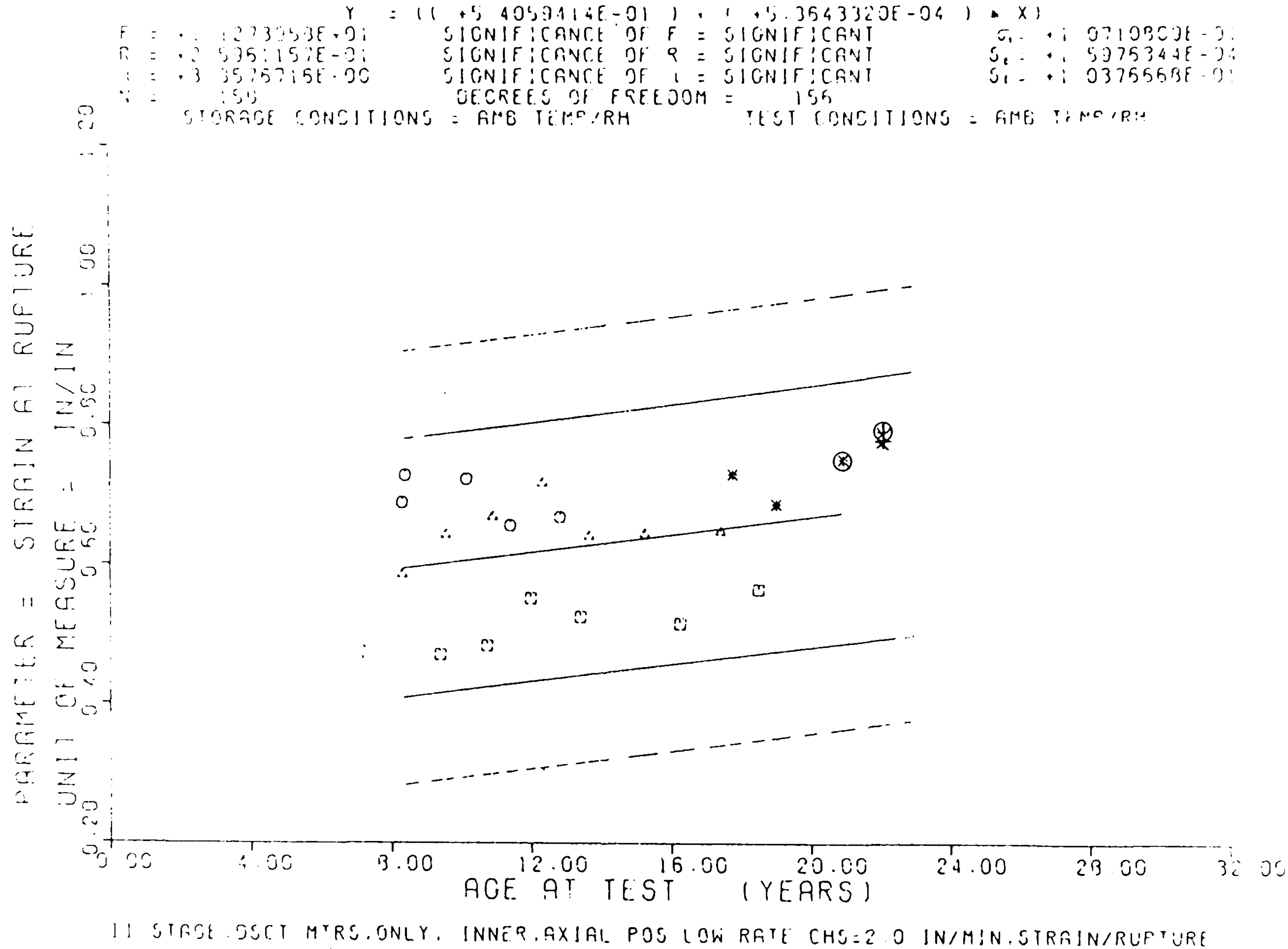
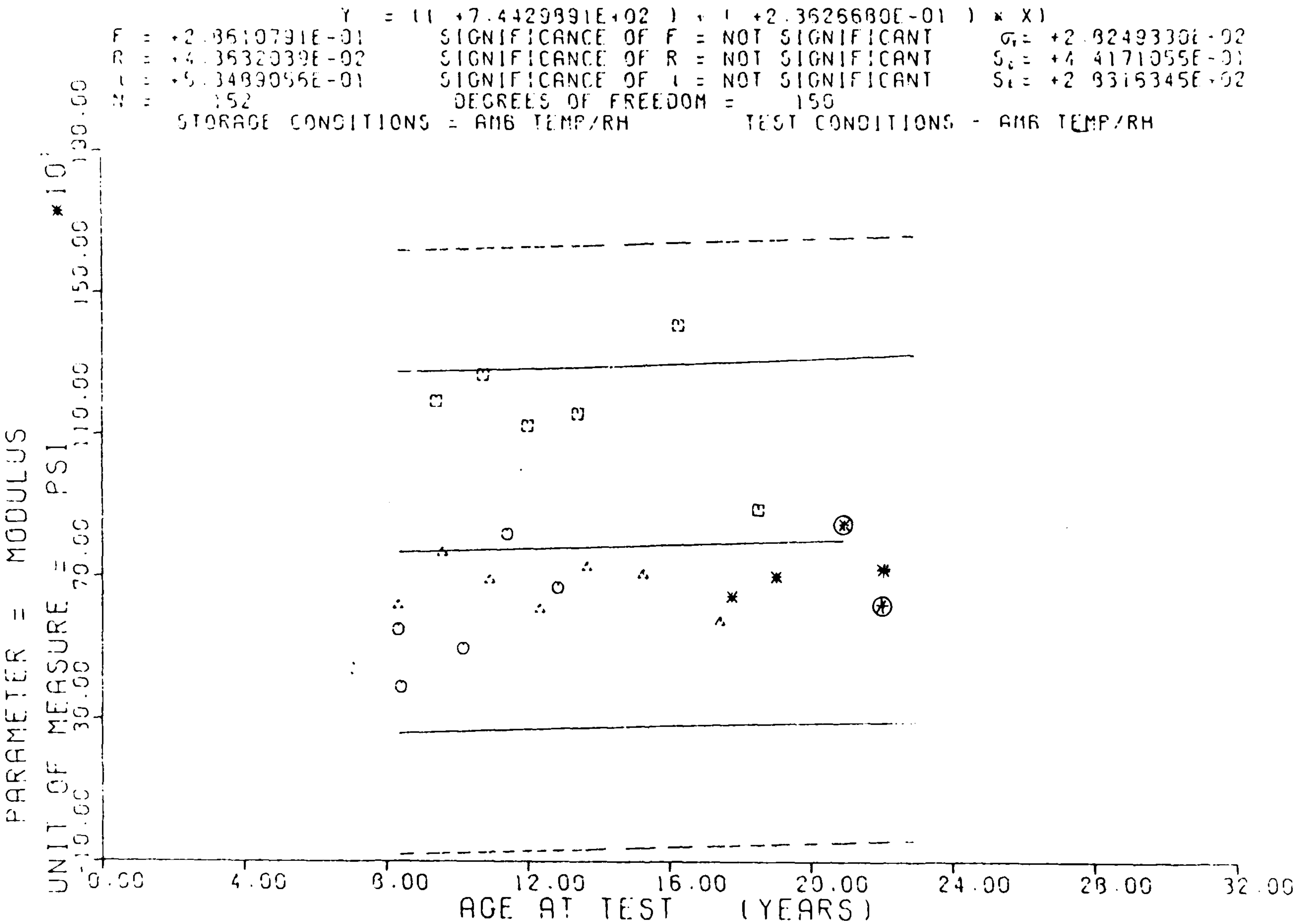

Y = ((+5.4059414E-01) + (+5.3643320E-04) * X)
SIGNIFICANCE OF F = SIGNIFICANT
SIGNIFICANCE OF R = SIGNIFICANT
SIGNIFICANCE OF t = SIGNIFICANT
DEGREES OF FREEDOM = 156
STORAGE CONDITIONS = AMB TEMP/RH
TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
AGE AT TEST (YEARS)
0.20
0.40
0.60
1.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
INNER,AXIAL POS LOW RATE CHS=2.0 IN/MIN,STRAIN/RUPTURE

FIGURE 19



II STAGE DSCT MTRS.ONLY, INNER,AXIAL POS.LOW RATE CHS=2.0 IN/MIN, MODULUS

FIGURE 20

TABLE 3

MOTOR 0022687
LOW RATE RAILS
0.2 IN/MIN

UNCONDITIONED ANX (OUTER)

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	99.3	.352	87.9	.442	669
	104.0	.352	97.1	.424	682
	104.1	.354	94.2	.450	659
X=	102.47	.3527	93.07	.4387	670
SD=	2.743	.00115	4.704	.01332	11.533

CONDITIONED

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	73.4	.221	54.0	.369	503
	75.2	.209	49.6	.393	521
	75.9	.213	56.4	.359	519
	74.4	.223	53.3	.384	522
	75.7	.211	55.1	.368	536
	76.2	.213	52.9	.381	531
X=	75.13	.2150	53.55	.3757	522.0
SD=	1.0577	.005657	2.3158	.01248	11.3842

UNCONDITIONED ANY (INNER)

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	108.3	.530	102.4	.610	426
	108.8	.533	102.3	.619	406
	101.9	.528	94.3	.643	380
X=	106.33	.5303	99.67	.6240	406.0
SD=	3.847	.00252	4.648	.01706	20.0

CONDITIONED

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	79.9	.344	68.1	.484	345
	79.1	.330	72.7	.407	355
	80.3	.330	65.8	.512	369
	81.1	.321	63.5	.544	381
	80.0	.326	63.7	.538	373
	80.0	.337	64.0	.538	353
X=	80.07	.3313	66.30	.5038	362.7
SD=	.647	.00814	3.587	.05251	13.76

Y = ((+9.9287963E+01) + (+9.4468770E-03) * X)

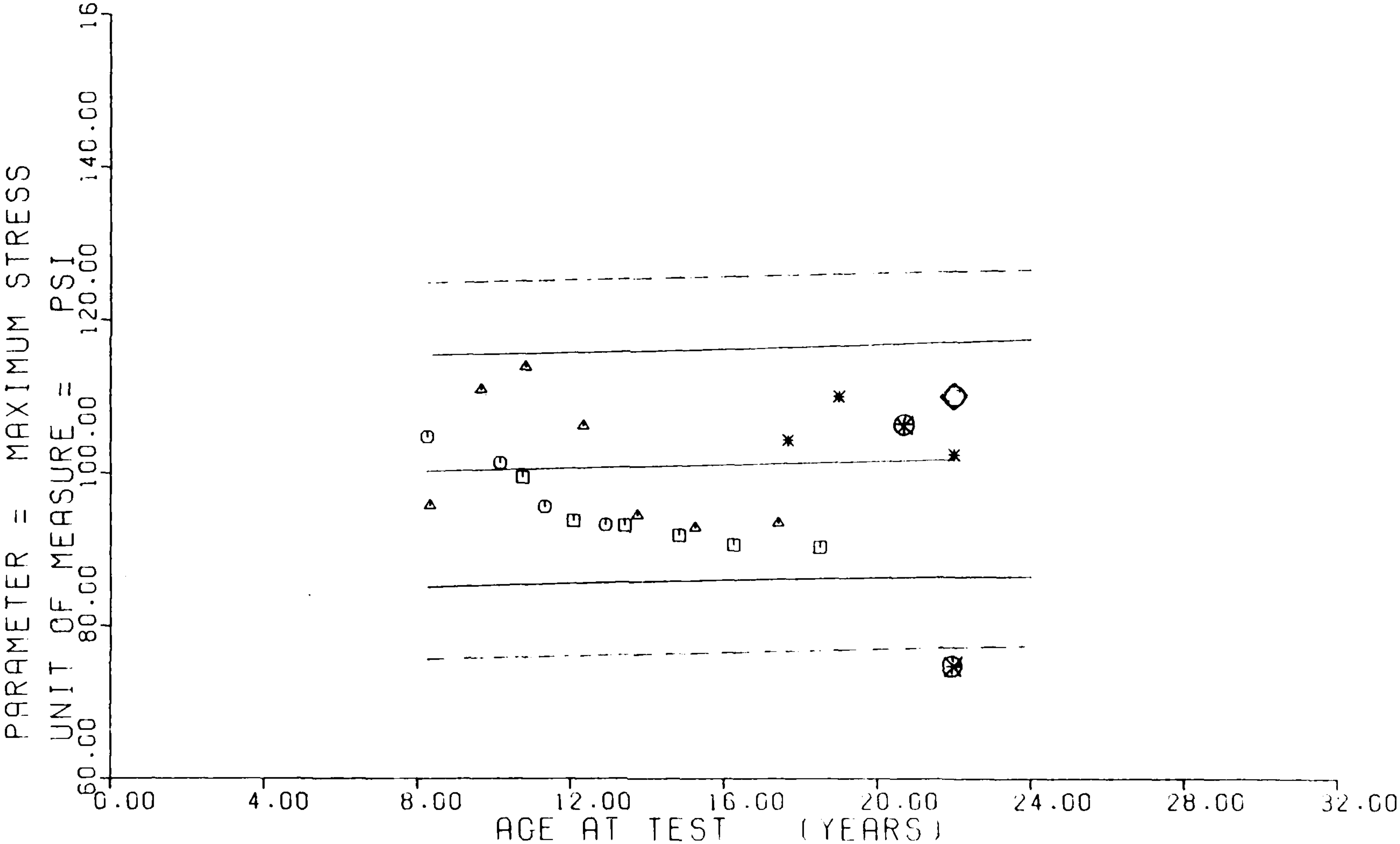
F = +3.4866291E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +8.1748696E+00

R = +6.1115142E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +1.5998725E-02

t = +5.9047685E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT S_E = +8.2033399E+00

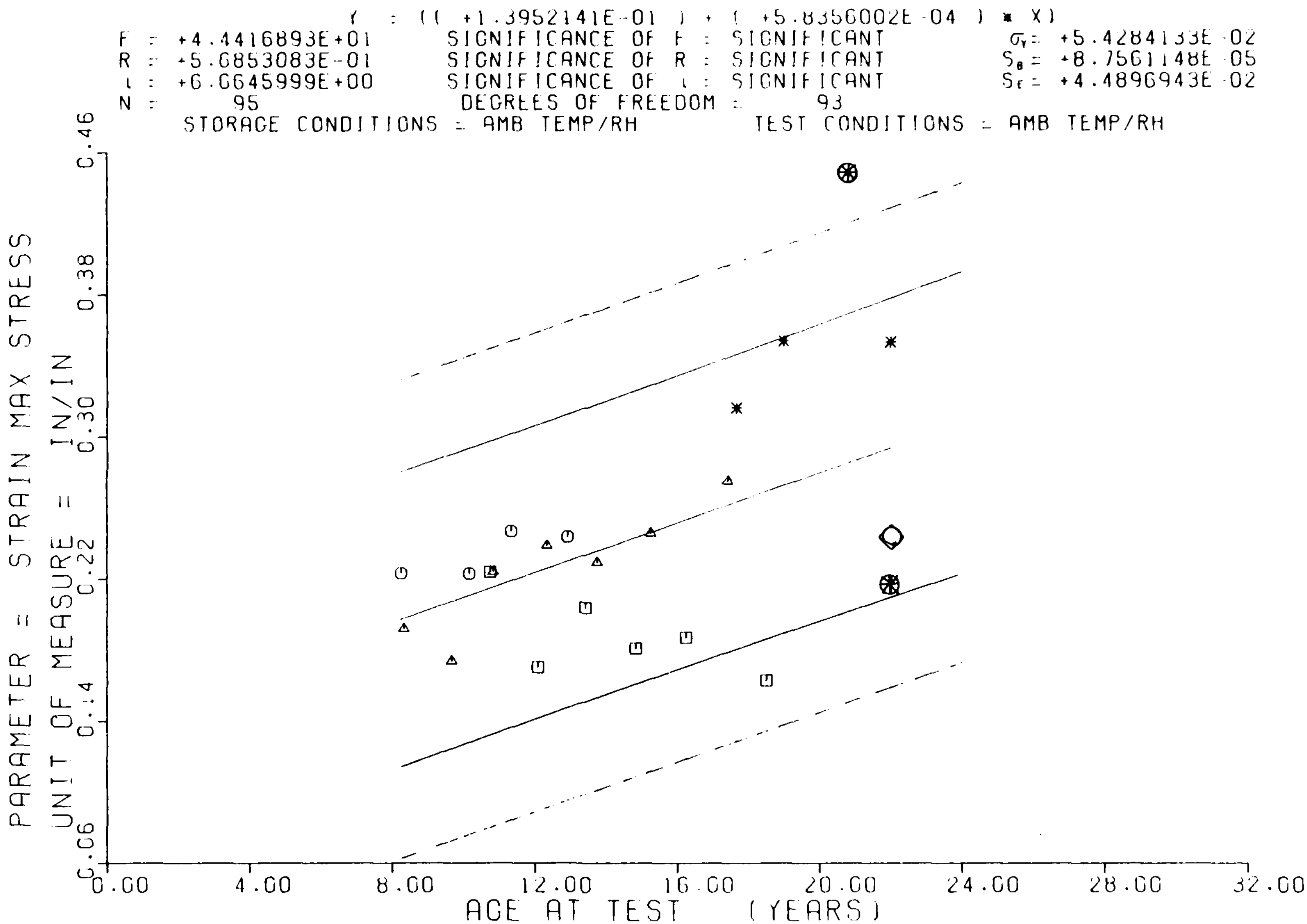
N = 95 DEGREES OF FREEDOM = 93

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



II STAGE DSCT MTRS ONLY,OUTER,AXIAL POS.BIAXIAL CHS:0.2 IN/MIN,MAXIMUM STRESS

FIGURE 21



II STAGE DSCT MTRS ONLY,OUTER,AXIAL POS.BIAXIAL CHS=0.2 IN/MIN,STRAIN MAX STRS.

FIGURE 22

Y = ((+6.6265449E+01) + (+7.9653818E-02) * X)

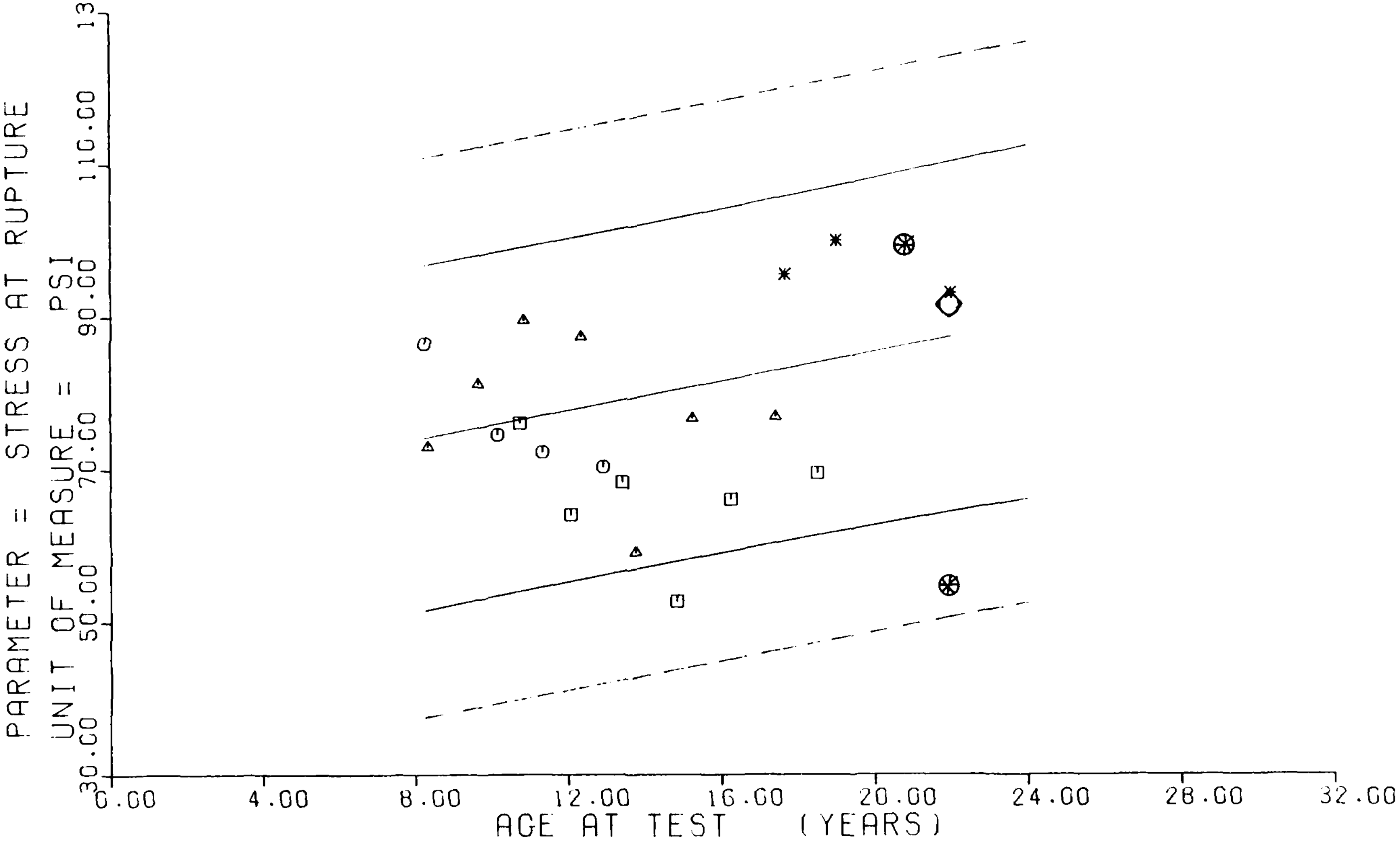
F = +1.1164847E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +1.2867145E+01

R = +3.2739029E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +2.3838570E-02

ι = +3.3413840E+00 SIGNIFICANCE OF ι = SIGNIFICANT S_E = +1.2223217E+01

N = 95 DEGREES OF FREEDOM = 93

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



II STAGE DSCT MTRS ONLY,OUTER,AXIAL POS.BIAXIAL CHS:0.2 IN/MIN,STRESS/RUPTURE

FIGURE 23

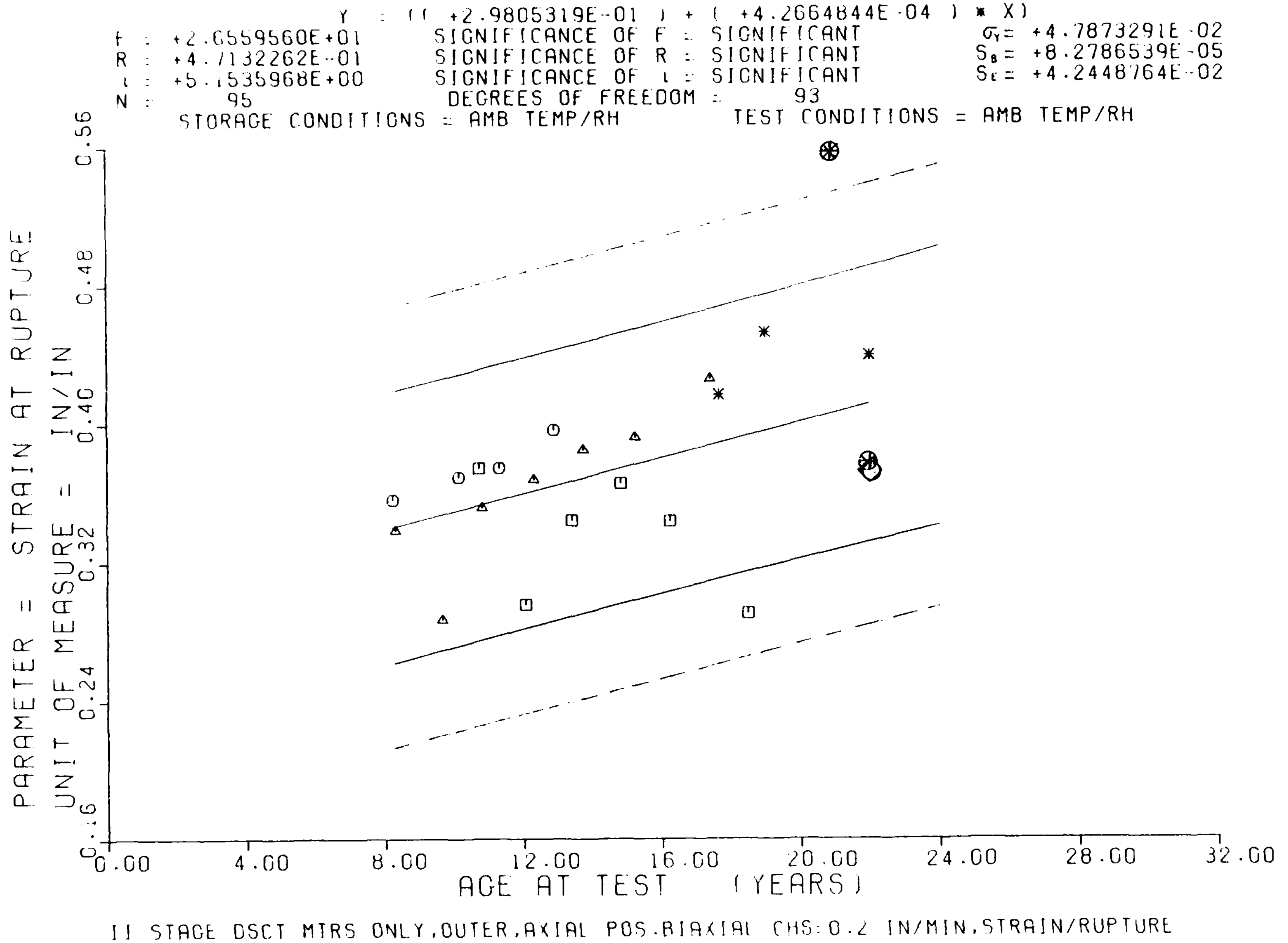
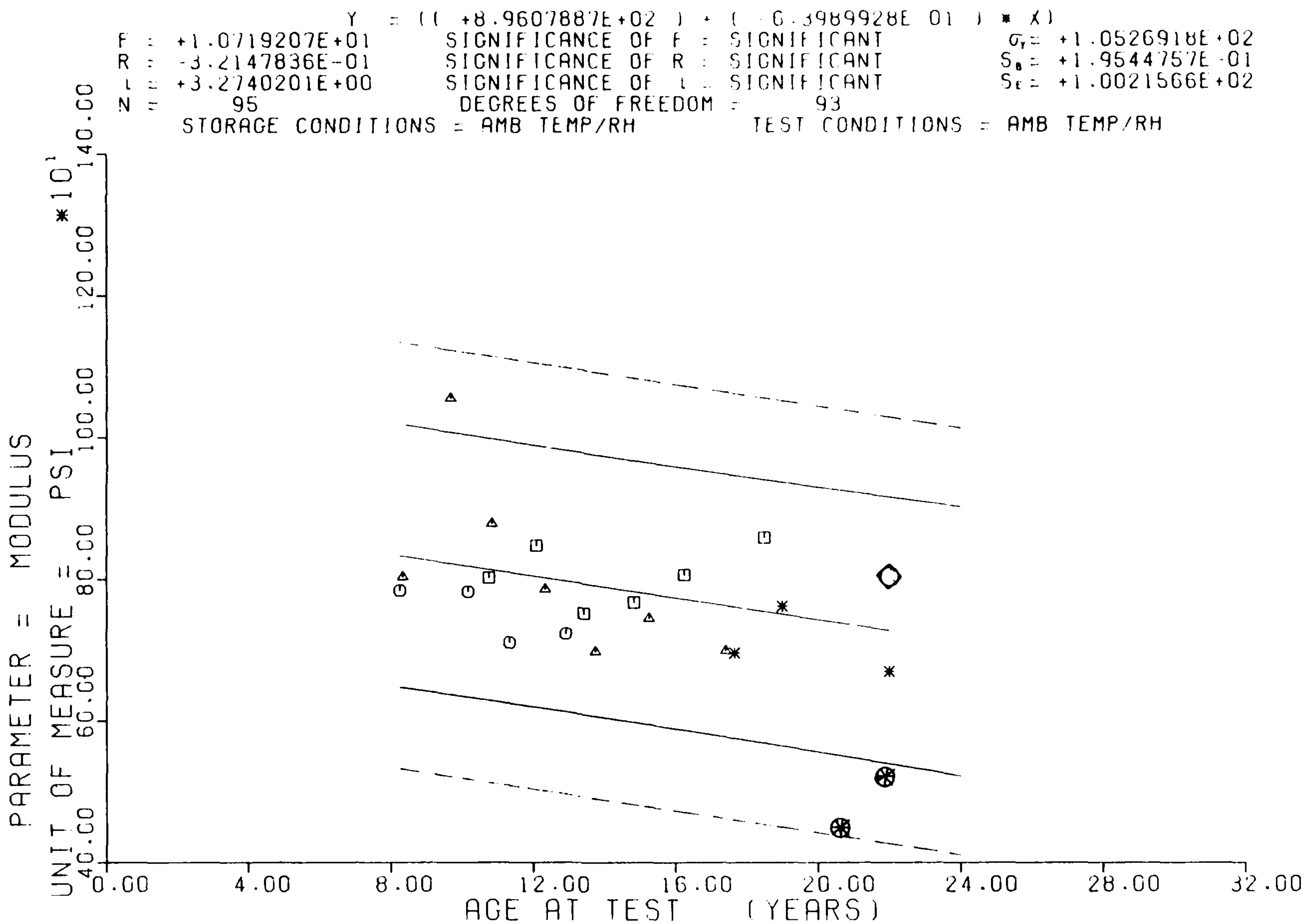

Y = ((+2.9805319E-01) + (+4.2664844E-04) * X)
F = +2.6559560E+01 SIGNIFICANCE OF F = SIGNIFICANT
R = +4.7132262E-01 SIGNIFICANCE OF R = SIGNIFICANT
t = +5.1535968E+00 SIGNIFICANCE OF t = SIGNIFICANT
N = 95 DEGREES OF FREEDOM = 93
σY= +4.7873291E-02
SB= +8.2786539E-05
SE= +4.2448764E-02
STORAGE CONDITIONS = AMB TEMP/RH
TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
0.56
0.48
0.40
0.32
0.24
0.16
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
II STAGE DSCT MTRS ONLY,OUTER,AXIAL POS.BIAXIAL CHS:0.2 IN/MIN,STRAIN/RUPTURE

FIGURE 24



II STAGE DSCT MTRS ONLY,OUTER,AXIAL POS.BIAXIAL CHS:0.2 IN/MIN, MODULUS

FIGURE 25

Y = ((+1.1506434E+02) + (-2.3531642E-02) * X)

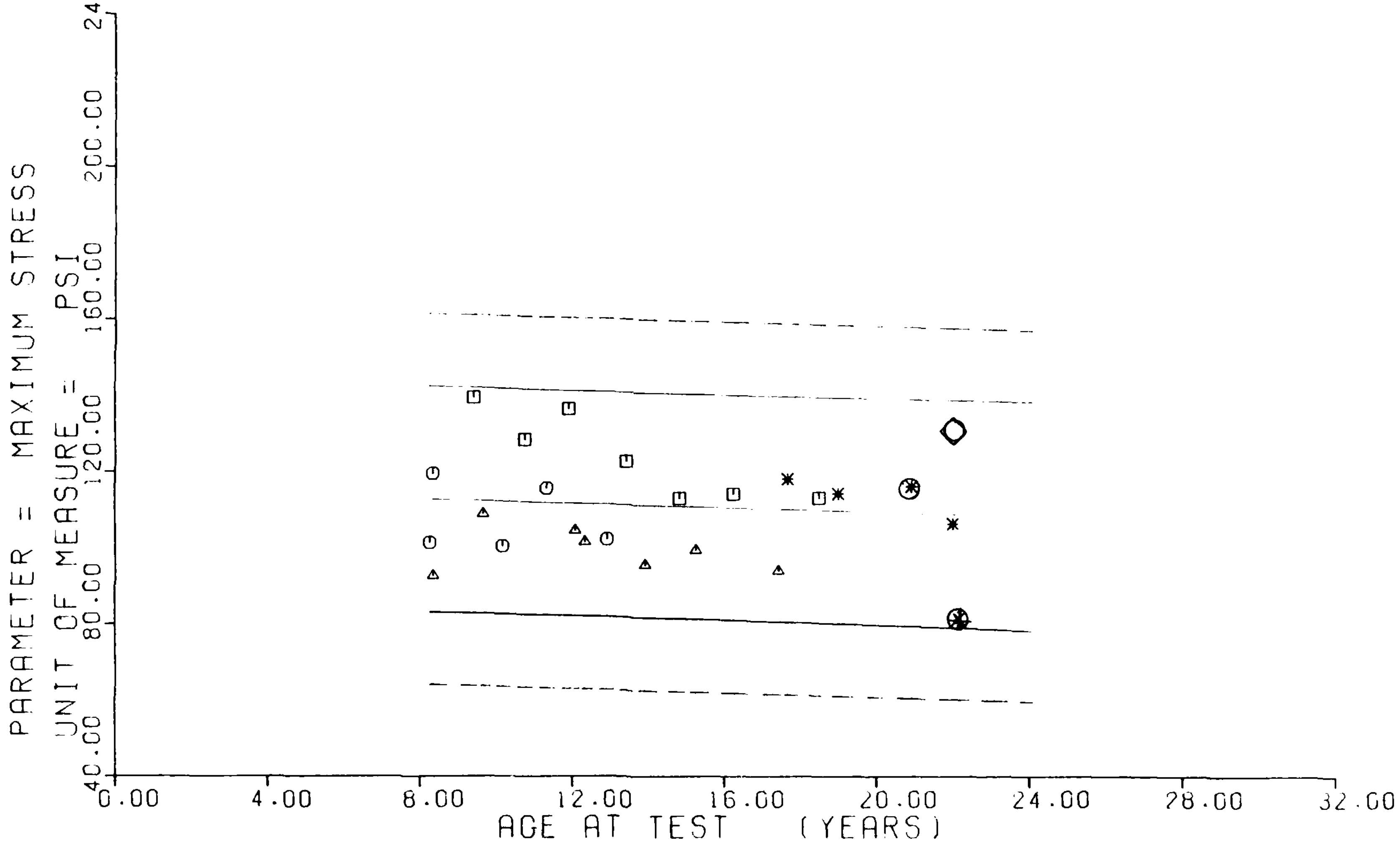
F = +7.9732233E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +1.6208097E+01

R = -8.2978906E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +2.6353316E-02

t = +8.9292907E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT S_E = +1.6222275E+01

N = 117 DEGREES OF FREEDOM = 115

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



STAGE II DISSECTED MTRS, INNER, AXIAL POS. BIAXIAL CHS=0.2 IN/MIN, MAX STRESS

FIGURE 26

Y = ((+2.5390283E-01) + (+5.6072750E-04) * X)

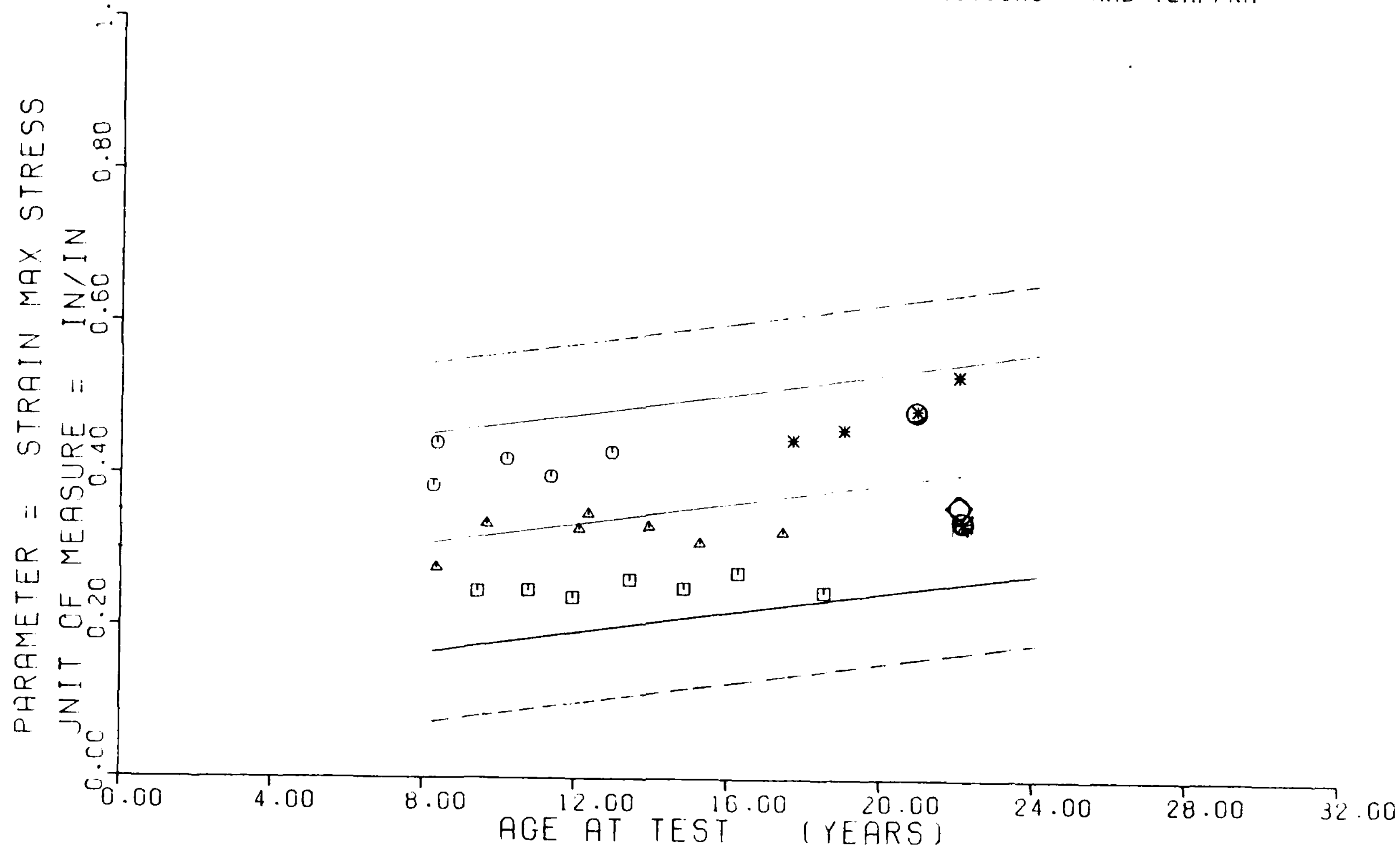
F = +1.9239140E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +8.4653734E-02

R = +3.7857615E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +1.2783772E-04

t = +4.3862444E+00 SIGNIFICANCE OF t = SIGNIFICANT S_E = +7.8692896E-02

N = 117 DEGREES OF FREEDOM = 115

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



II STAGE DSCT MTRS, INNER, AXIAL POS. BIAXIAL CHS=0.2 IN/MIN, STRAIN MAX STRS.

FIGURE 27

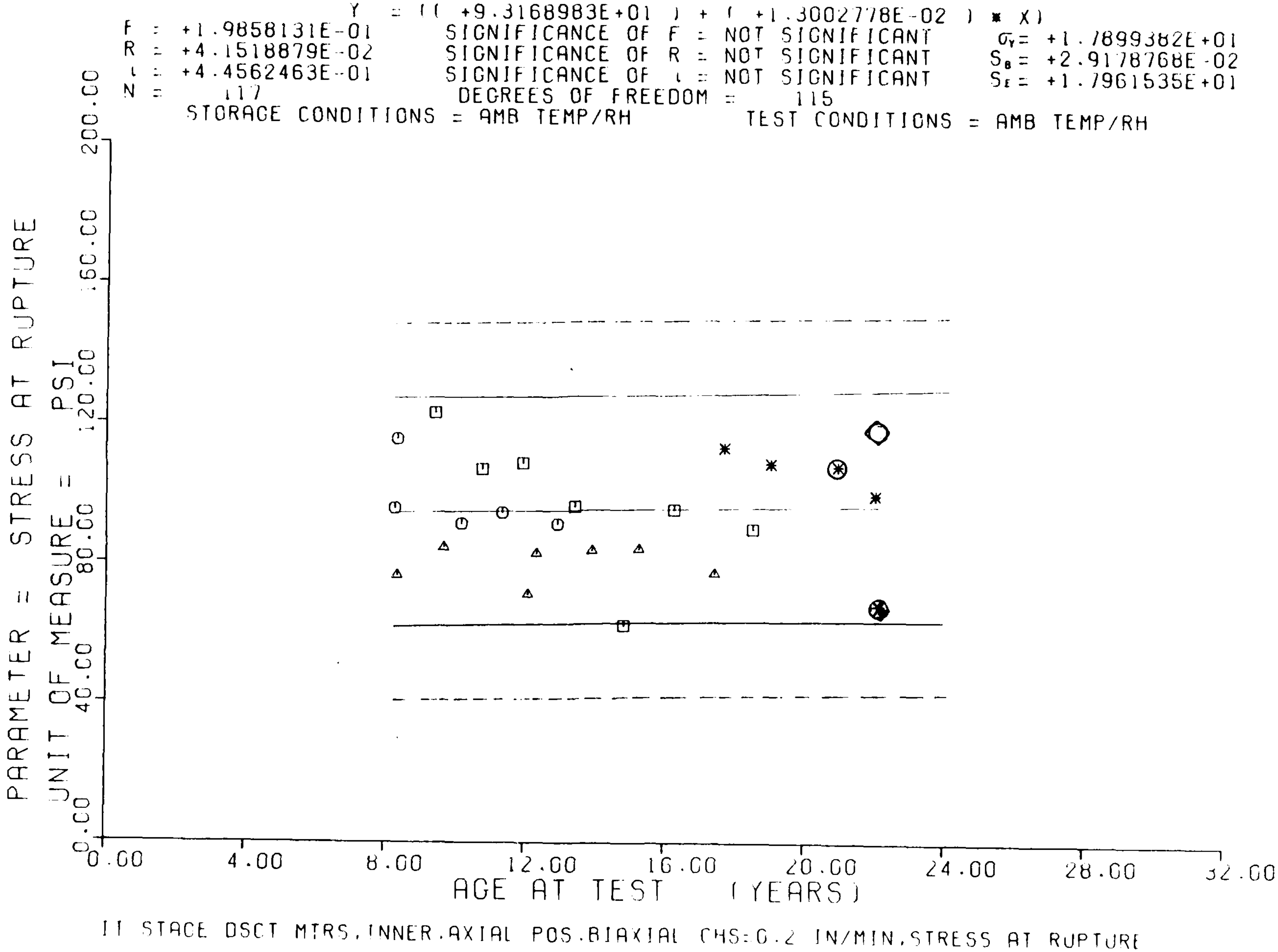
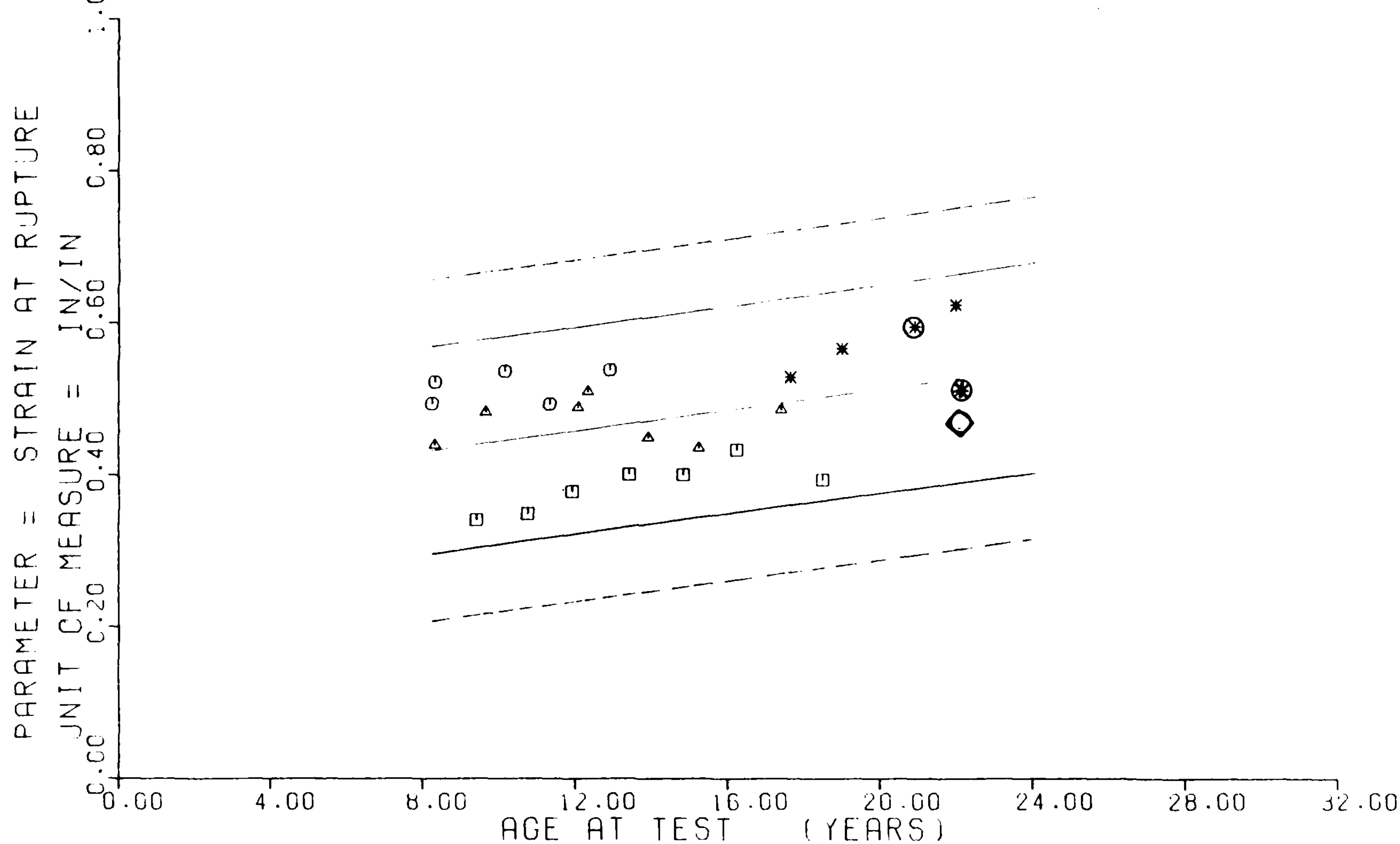

Y = ((+9.3168983E+01) + (+1.3002778E-02) * X)
F = +1.9858131E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +1.7899382E+01
R = +4.1518879E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +2.9178768E-02
ι = +4.4562463E-01 SIGNIFICANCE OF ι = NOT SIGNIFICANT S_E = +1.7961535E+01
N = 117 DEGREES OF FREEDOM = 115
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRESS AT RUPTURE
UNIT OF MEASURE = PSI
0.00
40.00
80.00
120.00
160.00
200.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
II STAGE DSCT MTRS, INNER, AXIAL POS. BIAXIAL CHS: 0.2 IN/MIN, STRESS AT RUPTURE

FIGURE 28

$Y = ((+3.7599443E-01) + (+5.6909620E-04) * X)$

F = +2.1871792E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +8.1452727E-02
R = +3.9974699E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +1.2181510E-04
t = +4.6767287E+00 SIGNIFICANCE OF t = SIGNIFICANT S_t = +7.4985561E-02
N = 117 DEGREES OF FREEDOM = 115
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



II STAGE DSCT MTRS,INNER,AXIAL POS.BIAXIAL CHS=0.2 IN/MIN,STRAIN AT RUPURE

FIGURE 29

Y = ((+7.3379615E+02) + (-9.0567654E-01) * X)

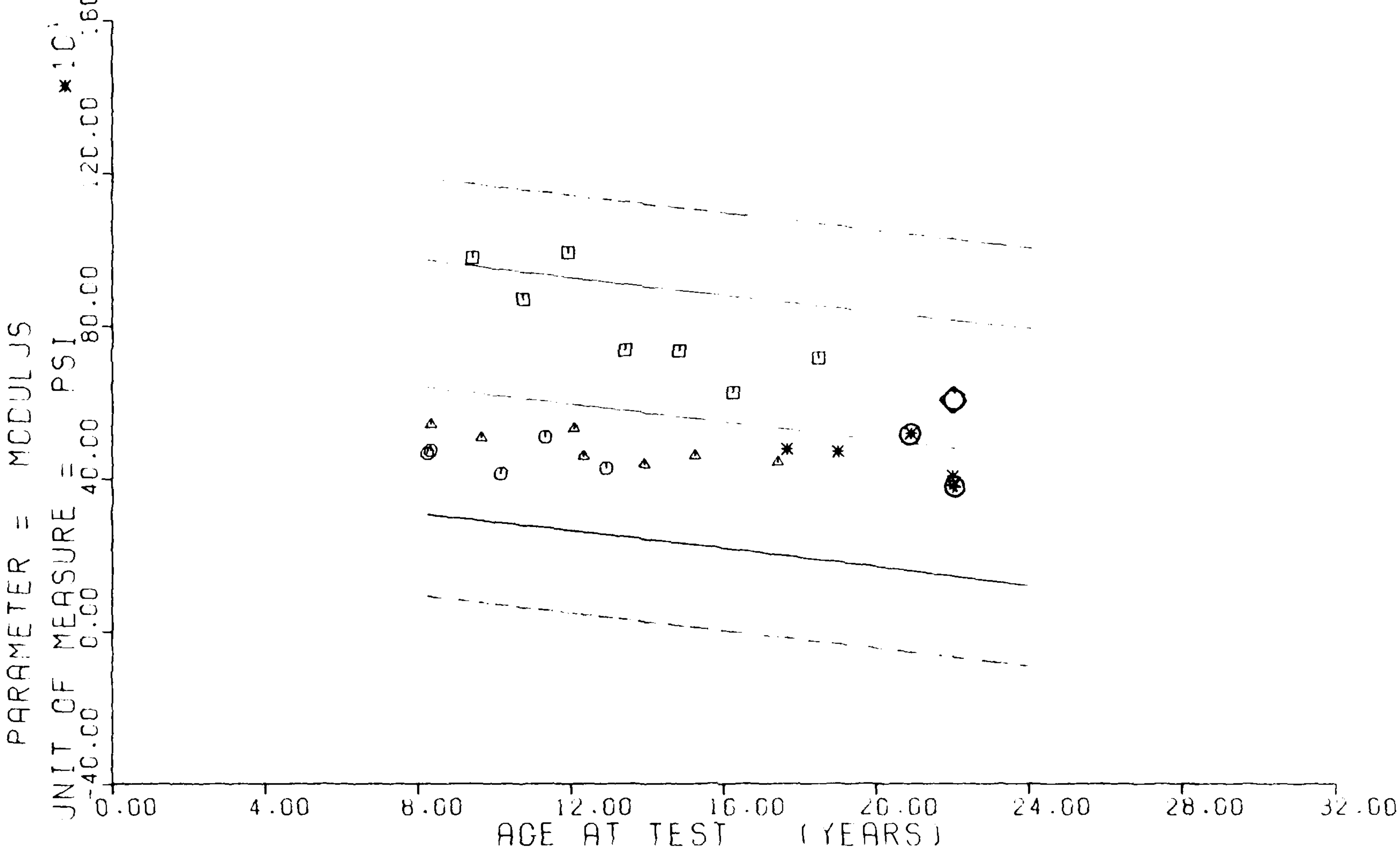
F = +1.0630881E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_r = +1.8973295E+02

R = -2.9089511E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +2.9617408E 01

t = +3.2605031E+00 SIGNIFICANCE OF t = SIGNIFICANT S_ε = +1.8231548E+02

N = 117 DEGREES OF FREEDOM = 115

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



II STAGE DSCT MTRS,INNER AXIAL POS.BIAXIAL CHS:0.2 IN/MIN, MODULUS

FIGURE 30

TABLE 4

MOTOR 0022687
HIGH RATE HYDROSTATIC
3/4 GL,500 PSI, 1750 IN/MIN

UNCONDITIONED ANX (OUTER)

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	544.4	.3277	517.4	.4508	4997
	540.4	.3312	514.2	.4456	4990
	547.4	.3756	521.4	.4575	4994
	544.0	.3346	517.6	.4382	5142
	544.5	.3841	513.7	.4882	4961
	534.7	.3875	508.2	.4763	5004
X=	542.57	.35678	513.75	.45943	5014.7
SD=	4.452	.028412	6.613	.019144	64.12

CONDITIONED

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	511.7	.3670	474.0	.4763	5103
	506.6	.3704	480.3	.4626	4613
	508.6	.3687	482.2	.4643	4579
	508.1	.3687	471.7	.4677	4363
	496.2	.3696	459.9	.4891	4358
	502.1	.3698	463.3	.4807	4596
X=	505.55	.36903	471.90	.47345	4602.0
SD=	5.551	.001194	8.933	.01039	271.42

UNCONDITIONED ANY (INNER)

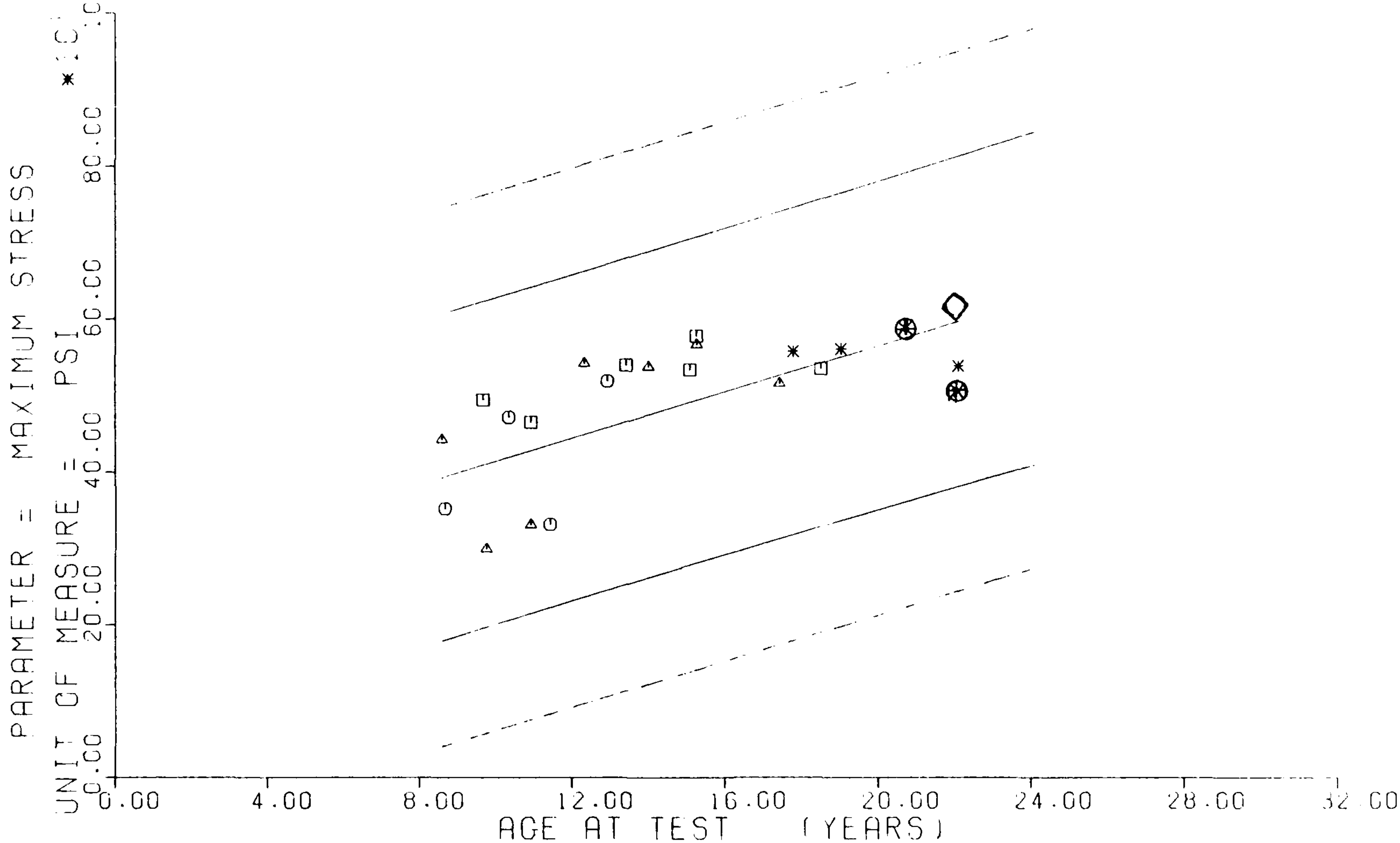
	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	571.2	.5497	534.9	.7563	4035
	571.3	.5651	545.2	.7563	4061
	578.1	.5616	556.6	.7153	3668
	565.2	.5581	545.1	.7151	4130
	583.9	.5463	558.5	.6948	4166
	579.6	.5463	538.0	.7221	4367
X=	574.88	.55452	546.38	.72665	4071.2
SD=	6.842	.008164	9.554	.024721	229.75

CONDITIONED

	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
	537.0	.4734	499.7	.6644	4158
	537.2	.4746	486.9	.7120	4050
	538.8	.4712	501.9	.7033	3944
	526.9	.5121	477.8	.7050	4025
	524.6	.4865	480.8	.7187	4050
	522.2	.5377	479.5	.7272	3696
X=	531.17	.49258	487.77	.70510	3987.2
SD=	7.354	.026840	10.575	.021821	158.21

Y = (+2.0362499E+02) + (+1.2563458E+00) * X)

F +4.2013191E+01 SIGNIFICANCE OF F : SIGNIFICANT σ_y = +1.3658697E+02
R +5.1563948E-01 SIGNIFICANCE OF R : SIGNIFICANT S_B = +1.9382793E-01
r +0.4817583E+00 SIGNIFICANCE OF r : SIGNIFICANT S_E = +1.1753183E+02
N 118 DEGREES OF FREEDOM : 116
STORAGE CONDITIONS : AMB TEMP/RH TEST CONDITIONS : AMB TEMP/RH



II STAGE DSCT MTRS,OUTER,AXIAL,H.R.HYDRO.CHS:1750 AT 500 PSI,MAXIMUM STRESS

FIGURE 31

Y = ((+2.9181576E-01) + (+2.7688610E-04) * X)

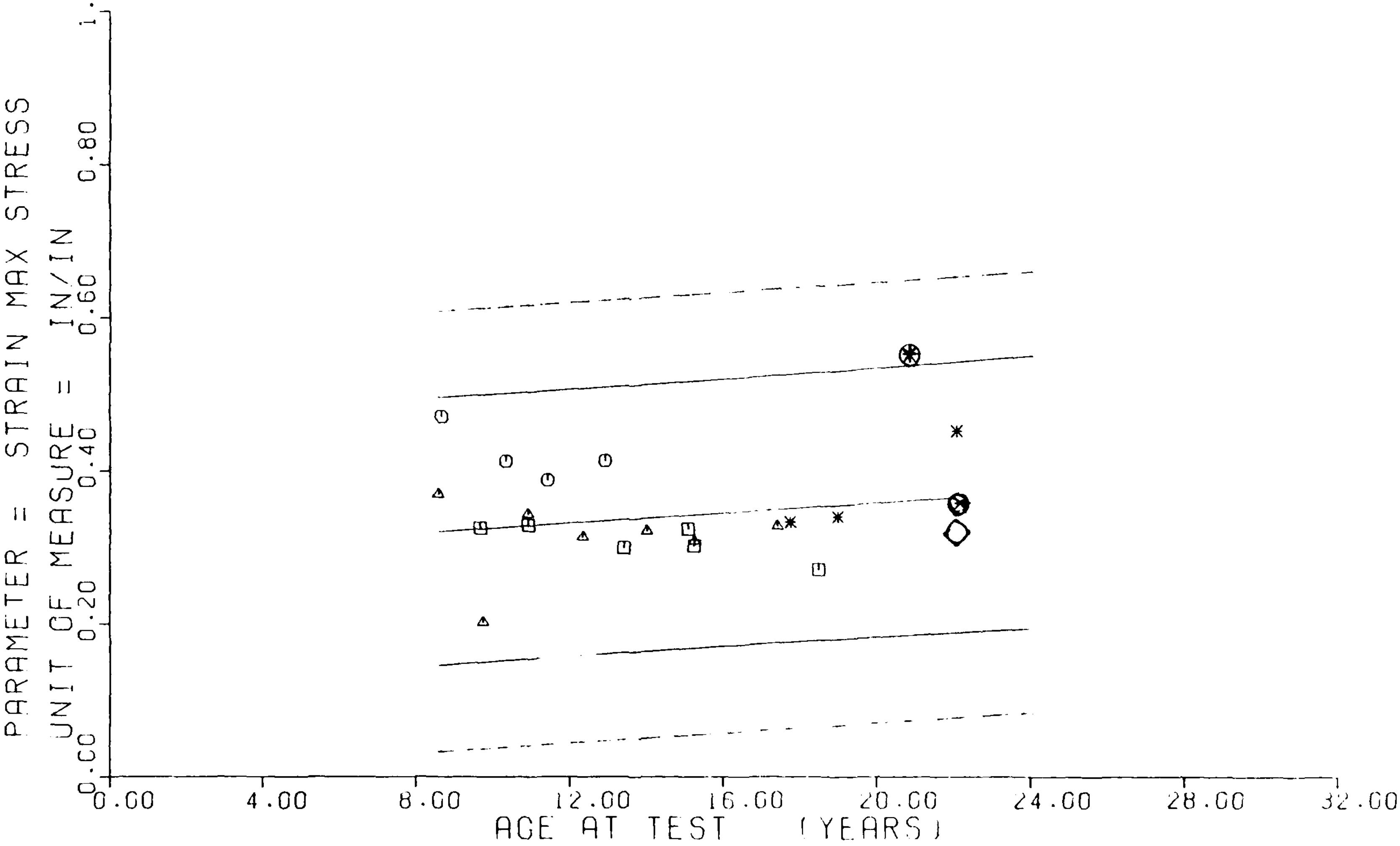
F = +2.9779746E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +9.6745949E-02

R = +1.5887663E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +1.6045038E-04

t = +1.7256809E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT S_t = +9.5931517E-02

N = 117 DEGREES OF FREEDOM = 115

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



II STAGE DSCT MTRS,OUTER,AXIAL,H.R.HYDRO.CHS=1750 AT 500 PSI,STRAIN MAX STRESS

FIGURE 32

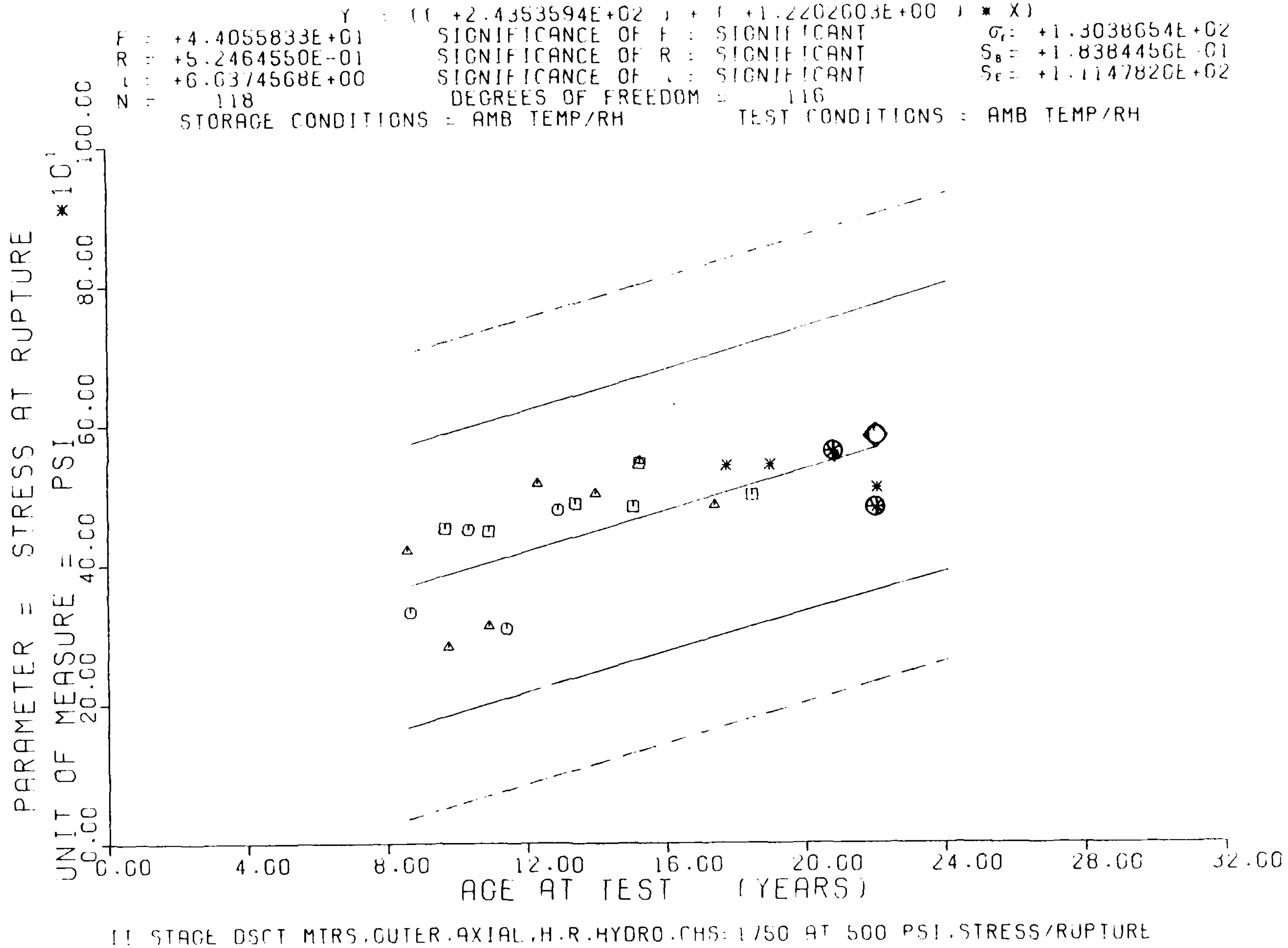
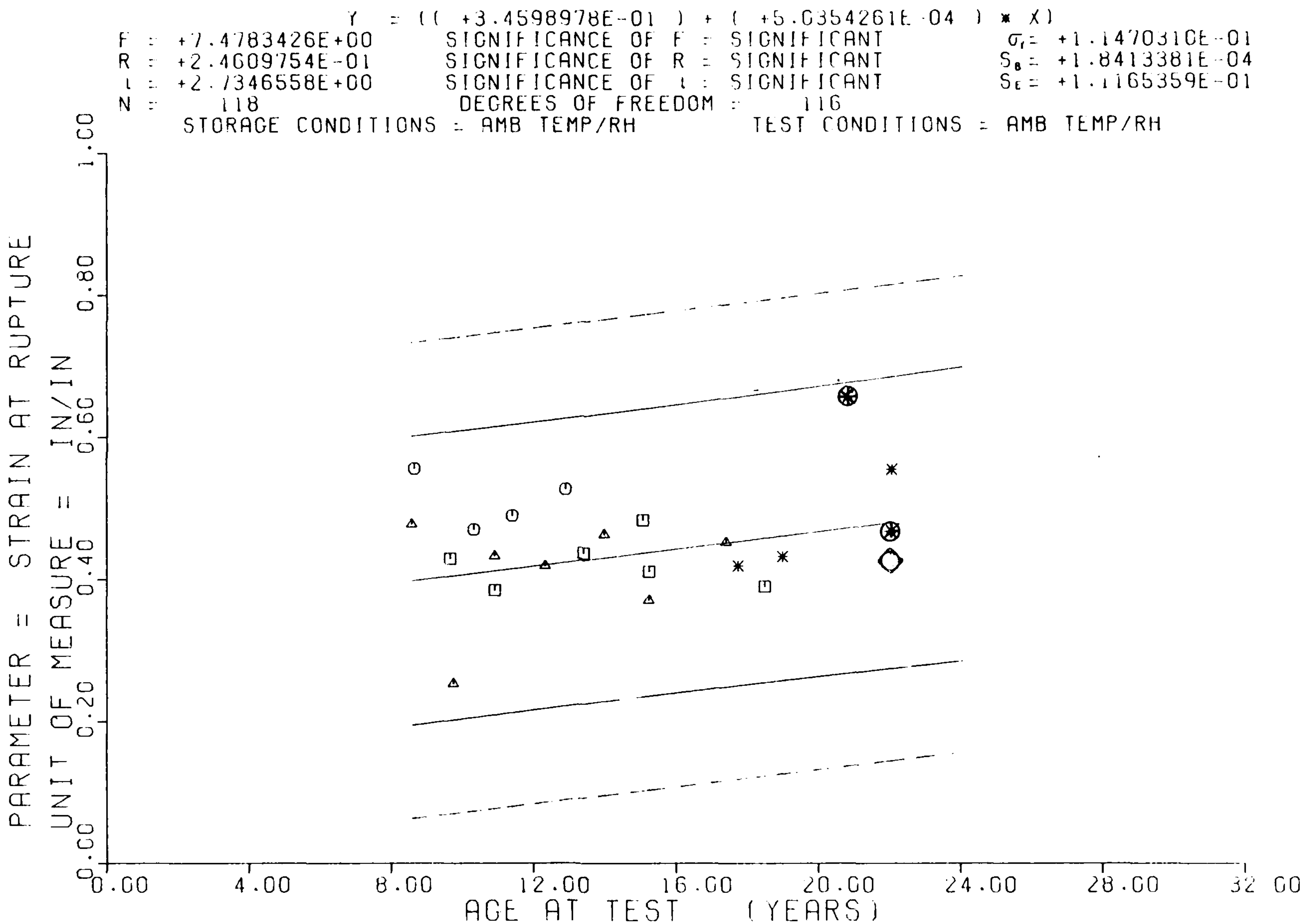

Y = ((+2.4353594E+02) + (+1.2202603E+00) * X)
F = +4.4055833E+01 SIGNIFICANCE OF F : SIGNIFICANT σ_r = +1.3038654E+02
R = +5.2464550E-01 SIGNIFICANCE OF R : SIGNIFICANT S_B = +1.8384456E-01
t = +6.6374568E+00 SIGNIFICANCE OF t : SIGNIFICANT S_E = +1.1147820E+02
N = 118 DEGREES OF FREEDOM = 116
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRESS AT RUPTURE
UNIT OF MEASURE = PSI *10¹
0.00
20.00
40.00
60.00
80.00
100.00
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
AGE AT TEST (YEARS)
II STAGE DSCT MTRS,OUTER,AXIAL,H.R.HYDRO.CHS:1/50 AT 500 PSI,STRESS/RUPTURE

FIGURE 33



II STAGE DSCT MTRS,OUTER,AXIAL,H.R.HYDRO.CHS:1/50 AT 500 PSI,STRAIN/RUPTURE

FIGURE 34

Y = ((+1.6791551E+03) + (+1.9573099E+01) * X)

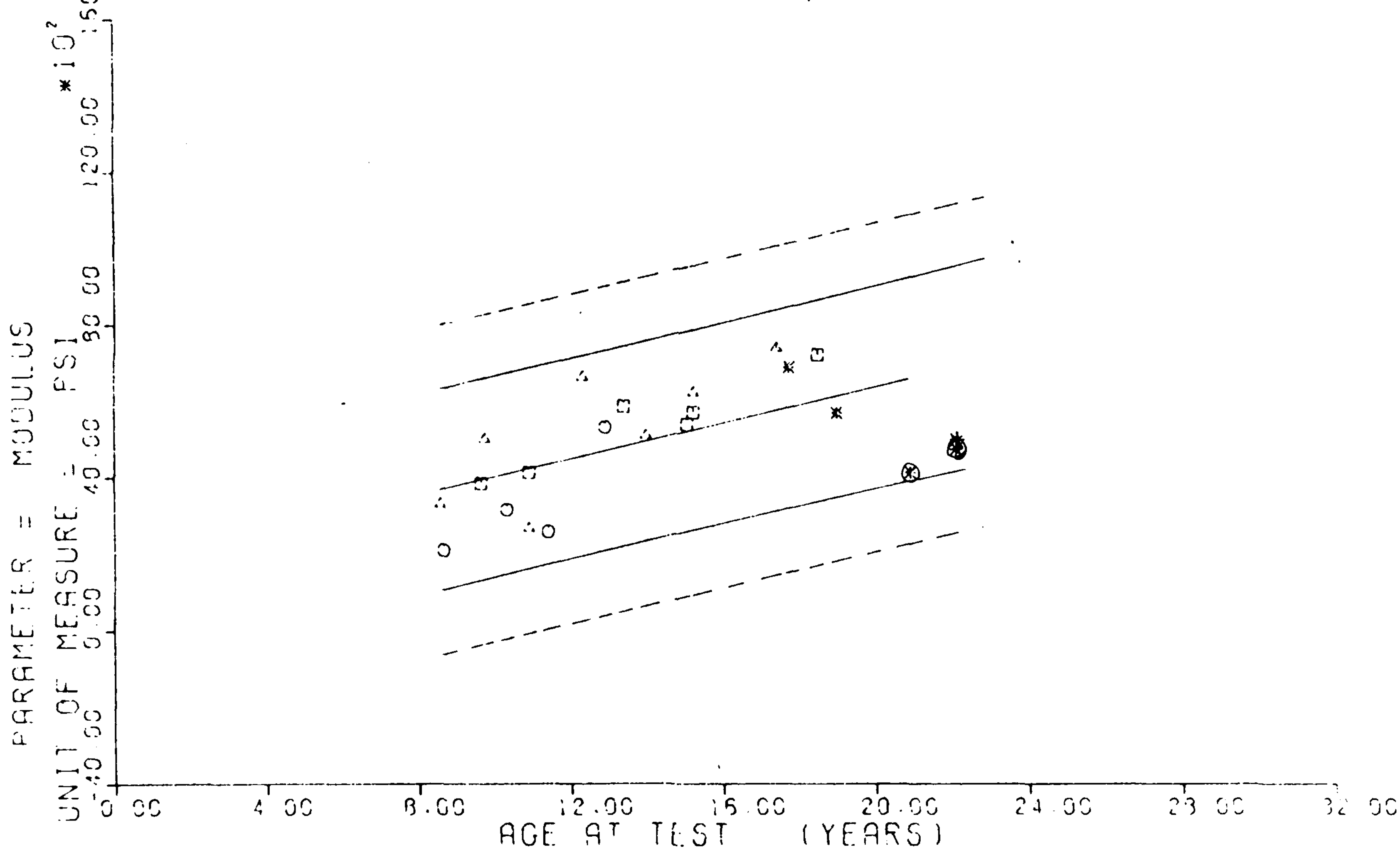
F = +4.2331404E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +1.6957827E+03

R = +5.3602330E-01 SIGNIFICANCE OF R = SIGNIFICANT S_a = +3.0083423E+00

t = +6.5062508E+00 SIGNIFICANCE OF t = SIGNIFICANT S_b = +1.4383861E-03

N = 107 DEGREES OF FREEDOM = 105

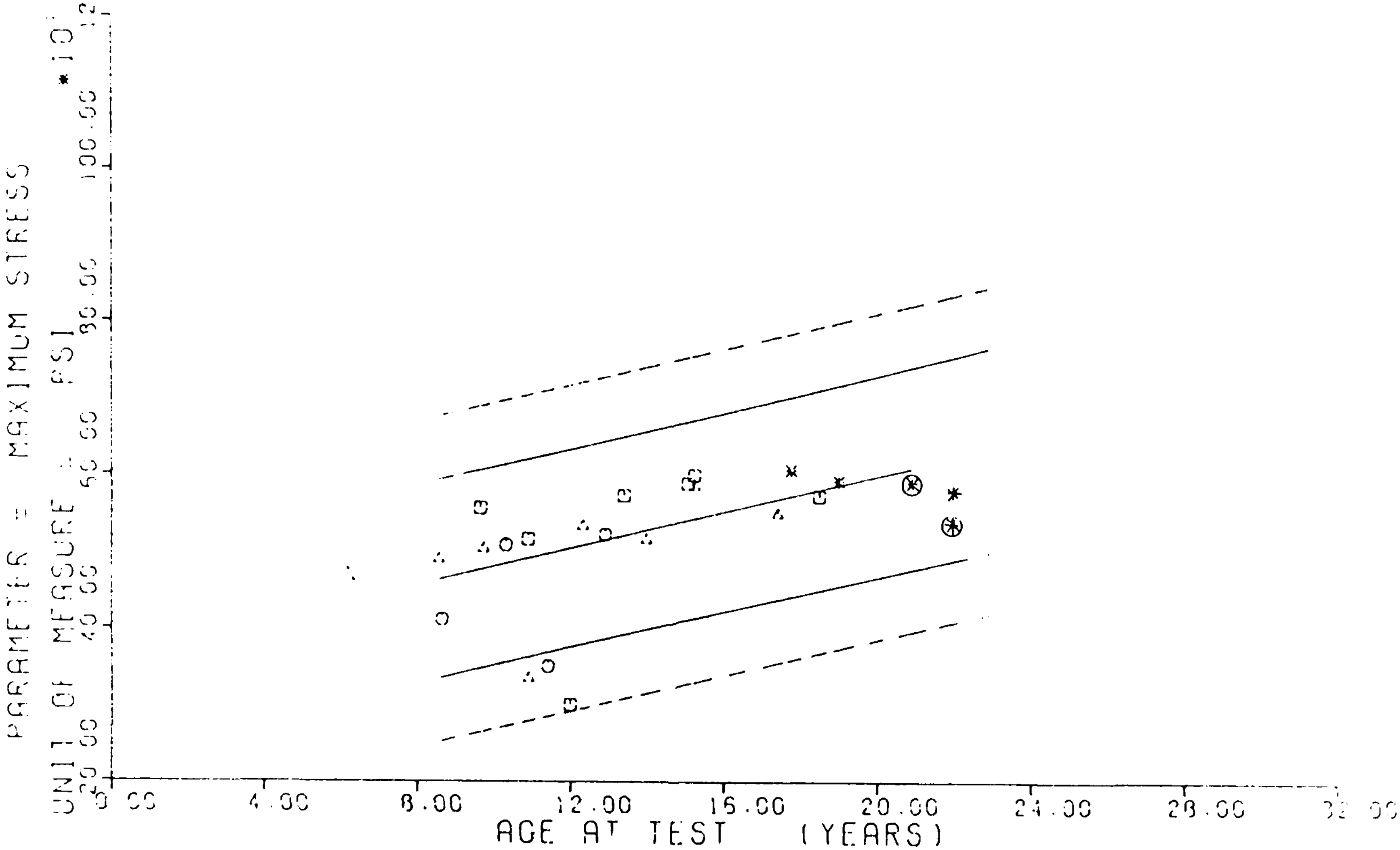
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



II STAGE DSCT MTRS.OUTER.AXIAL.H.R.HYDRO CHS=1750 AT 500 PSI. MODULUS

FIGURE 35

Y = ((+3.6360979E+02) + (+9.7461225E-01) * X)
F = +4.3537733E+01   SIGNIFICANCE OF F = SIGNIFICANT σ_i = +8.2714235E+01
R = +5.2737967E-01   SIGNIFICANCE OF R = SIGNIFICANT S_e = +1.4770627E+01
t = +6.5983123E+00   SIGNIFICANCE OF t = SIGNIFICANT S_t = +7.0565746E+01
N = 115   DEGREES OF FREEDOM = 113
STORAGE CONDITIONS = AMB TEMP/RH   TEST CONDITIONS = AMB TEMP/RH



II STAGE OSCT MTRS,INNER,AXIAL,H.R HYDRO.CHS=1750 AT 500 PSI,MAXIMUM STRESS

FIGURE 36

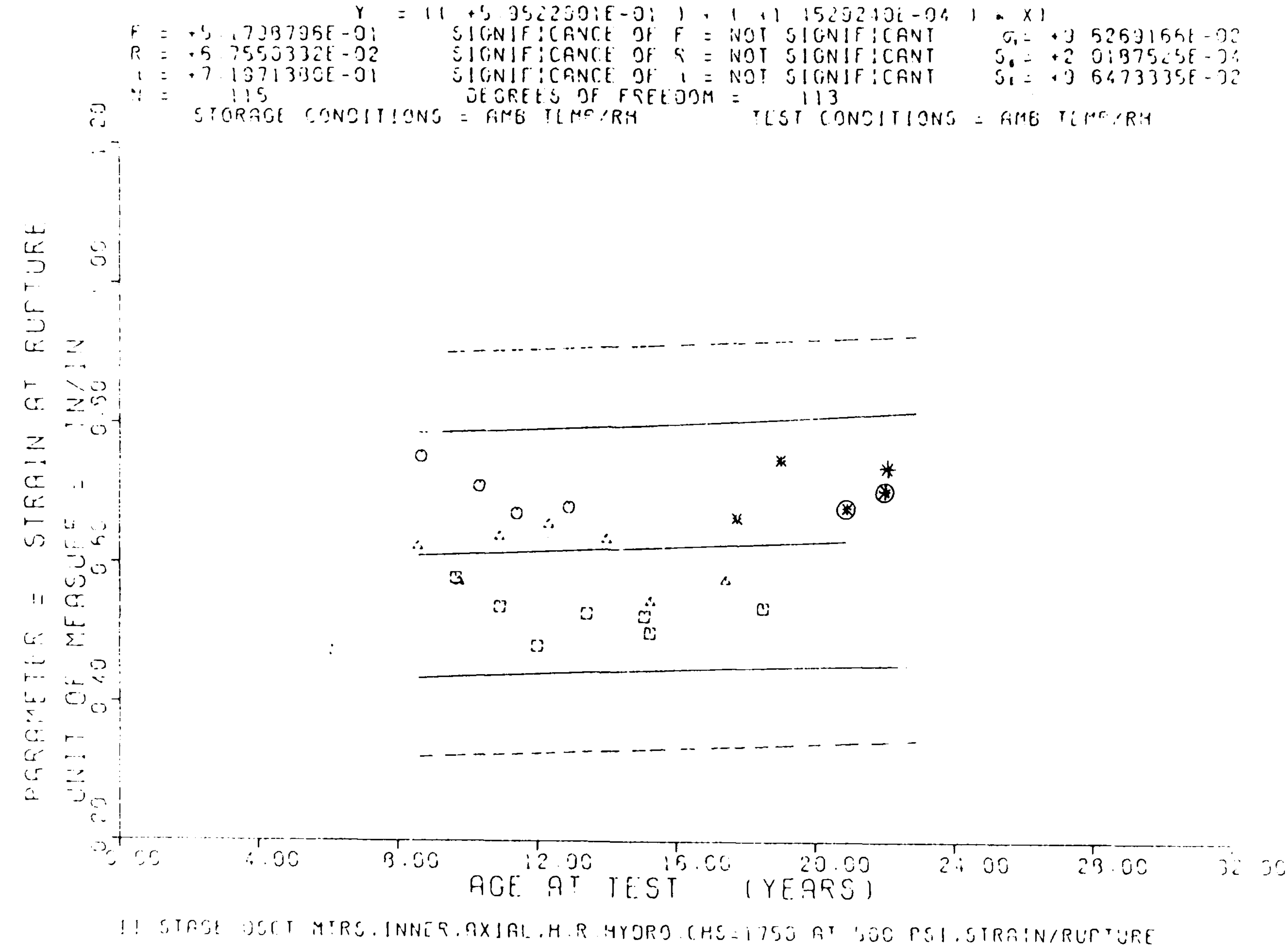
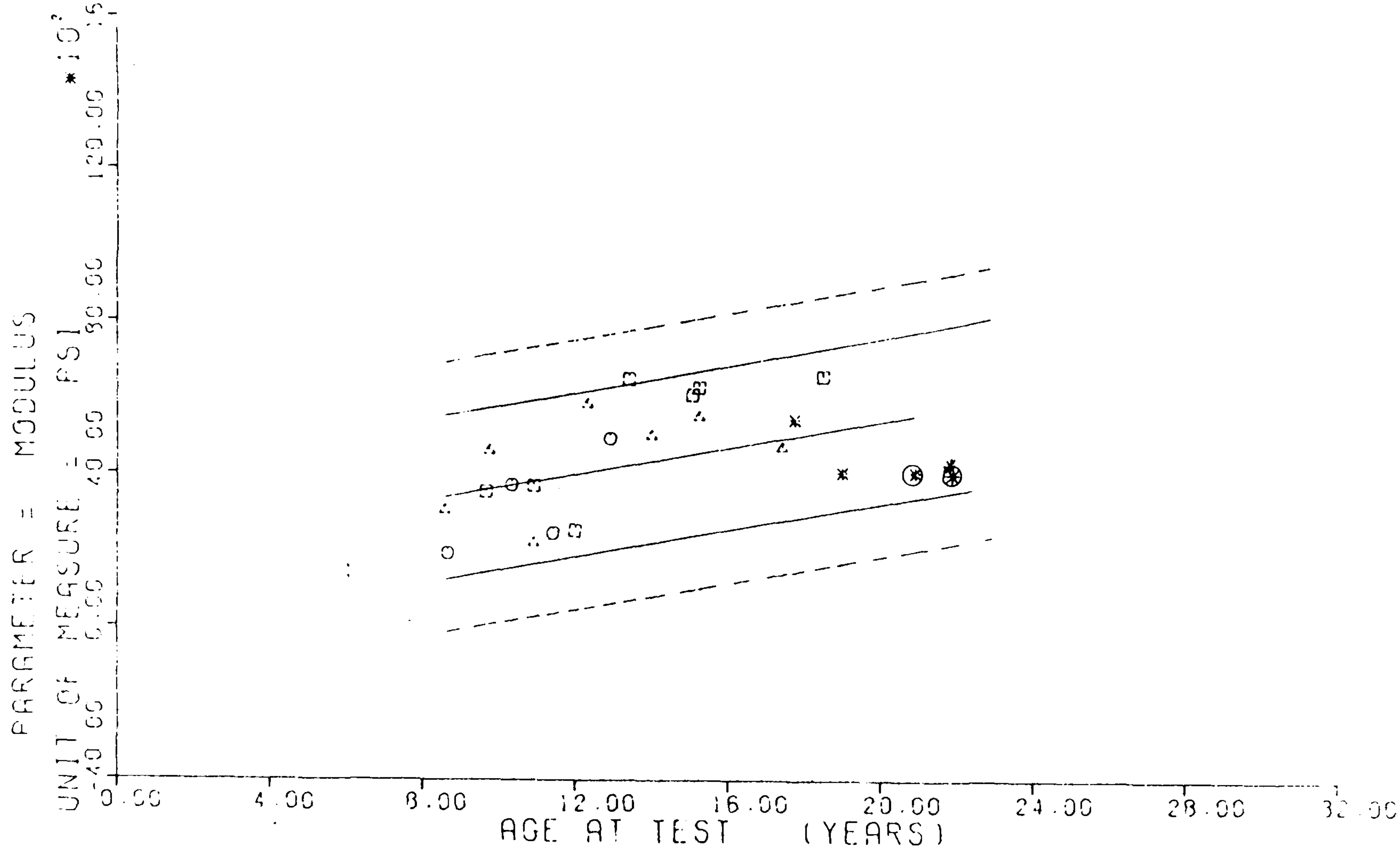

Y = ((+5.9522901E-01) + (+1.1529240E-04) * X)
F = +5.1708796E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT
R = +6.7550332E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT
T = +7.1871380E-01 SIGNIFICANCE OF T = NOT SIGNIFICANT
N = 115 DEGREES OF FREEDOM = 113
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH
PARAMETER = STRAIN AT RUPTURE
UNIT OF MEASURE = IN/IN
AGE AT TEST (YEARS)
0.00
4.00
8.00
12.00
16.00
20.00
24.00
28.00
32.00
0.20
0.40
0.60
0.80
1.00
1.20
II STAGE DSCT MTRS.INNER.AXIAL.H.R.HYDRO.CHS=1750 AT 500 PSI.STRAIN/RUPTURE

FIGURE 37

Y = ((+1.8897301E+03) + (+1.4517006E-01) * X)
F = +3.4867459E+01   SIGNIFICANCE OF F = SIGNIFICANT S_a = +1.3377650E+03
R = +4.8570090E-01   SIGNIFICANCE OF R = SIGNIFICANT S_b = +2.4577765E+00
t = +5.9065606E+00   SIGNIFICANCE OF t = SIGNIFICANT S_e = +1.1745367E+03
N = 115   DEGREES OF FREEDOM = 113
STORAGE CONDITIONS = AMB TEMP/RH   TEST CONDITIONS = AMB TEMP/RH



II STAGE DSCT MTRS, INNER, AXIAL, H.R. HYDRO. CHS=1750 AT 500 PSI, MODULUS

FIGURE 38

TABLE 5

MOTOR 0022687
MINITHIN TENSILE

CONDITIONED ANX (OUTER)

BLOCK 1

SLICE	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
1	83.5	.427	67.7	.634	596
2	84.4	.450	69.4	.621	518
3	84.5	.472	73.9	.663	680
6	85.1	.483	66.7	.741	571
10	85.2	.489	75.2	.650	443

BLOCK 2

SLICE	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
1	78.6	.454	61.2	.722	498
2	78.7	.450	65.7	.664	530
3	80.2	.474	70.8	.656	536
6	83.1	.465	71.9	.665	515
10	81.1	.455	70.7	.652	590

BLOCK 3

SLICE	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
1	83.5	.415	66.4	.642	564
2	81.6	.423	67.0	.650	536
3	85.5	.435	70.9	.643	593
6	88.2	.435	79.0	.595	576
10	88.5	.440	70.4	.668	631

BLOCK 4

SLICE	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
1	79.8	.427	64.4	.665	541
2	78.5	.412	68.7	.586	644
3	80.6	.419	69.1	.590	573
6	83.1	.429	75.8	.554	633
10	82.9	.434	72.6	.589	499

UNCONDITIONED

BLOCK 5

SLICE	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
1	96.7	.410	89.4	.493	649
2	93.1	.458	83.0	.612	535
3	91.3	.471	82.0	.630	550
6	93.2	.475	82.3	.652	575
10	94.4	.472	87.4	.582	623

BLOCK 6

SLICE	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
1	85.5	.416	68.0	.640	520
2	85.1	.458	74.7	.626	513
3	86.1	.462	73.0	.659	521
6	87.0	.457	79.7	.594	526
10	88.0	.461	75.0	.653	600

TABLE 5 (CONT'D)

MOTOR 0022687
MINITHIN TENSILE

CONDITIONED ANY (INNER)

BLOCK 1

SLICE	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
1	122.5	.661	115.0	.769	639
2	114.6	.666	107.9	.778	648
3	114.5	.662	106.1	.792	483
6	115.1	.700	107.3	.830	532
10	108.5	.709	104.3	.757	600

BLOCK 2

SLICE	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
1	120.9	.686	116.8	.757	636
2	114.7	.665	108.3	.777	965
3	116.2	.682	110.7	.757	655
6	112.3	.742	104.3	.873	576
10	105.8	.631	104.1	.651	585

BLOCK 3

SLICE	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
1	128.2	.670	123.8	.739	704
2	116.9	.654	110.0	.769	748
3	113.5	.661	108.9	.799	687
6	116.6	.670	109.7	.778	722
10	111.0	.735	104.9	.839	602

BLOCK 4

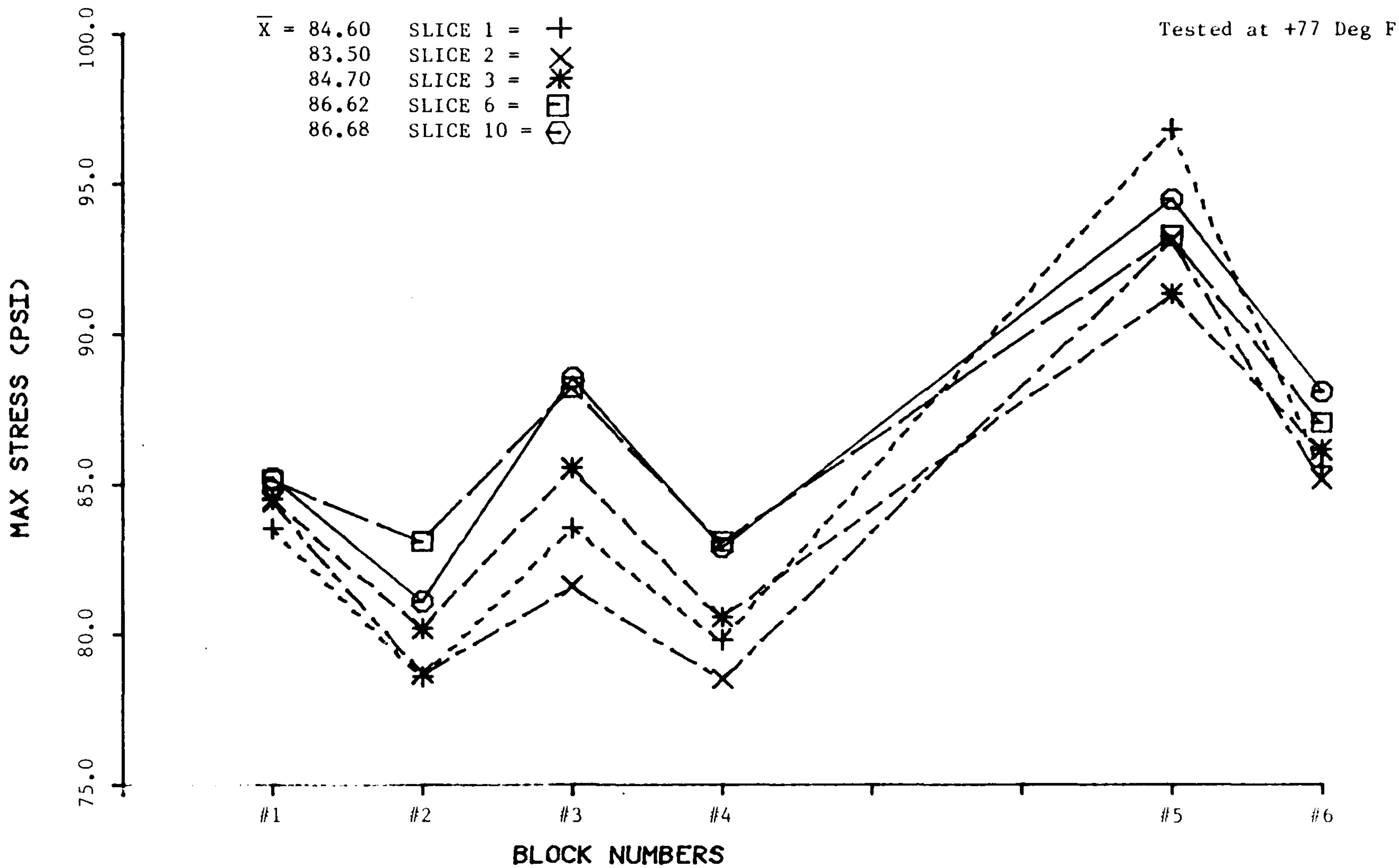
SLICE	MAXIMUM STRESS	STRAIN @ MAX STR	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
1	128.4	.679	117.6	.803	659
2	119.8	.668	111.3	.788	674
3	119.1	.657	110.1	.789	563
6	116.1	.693	109.2	.819	575
10	112.2	.735	105.9	.845	543

TABLE 5

MOTOR 0022687
MINITHIN TENSILE

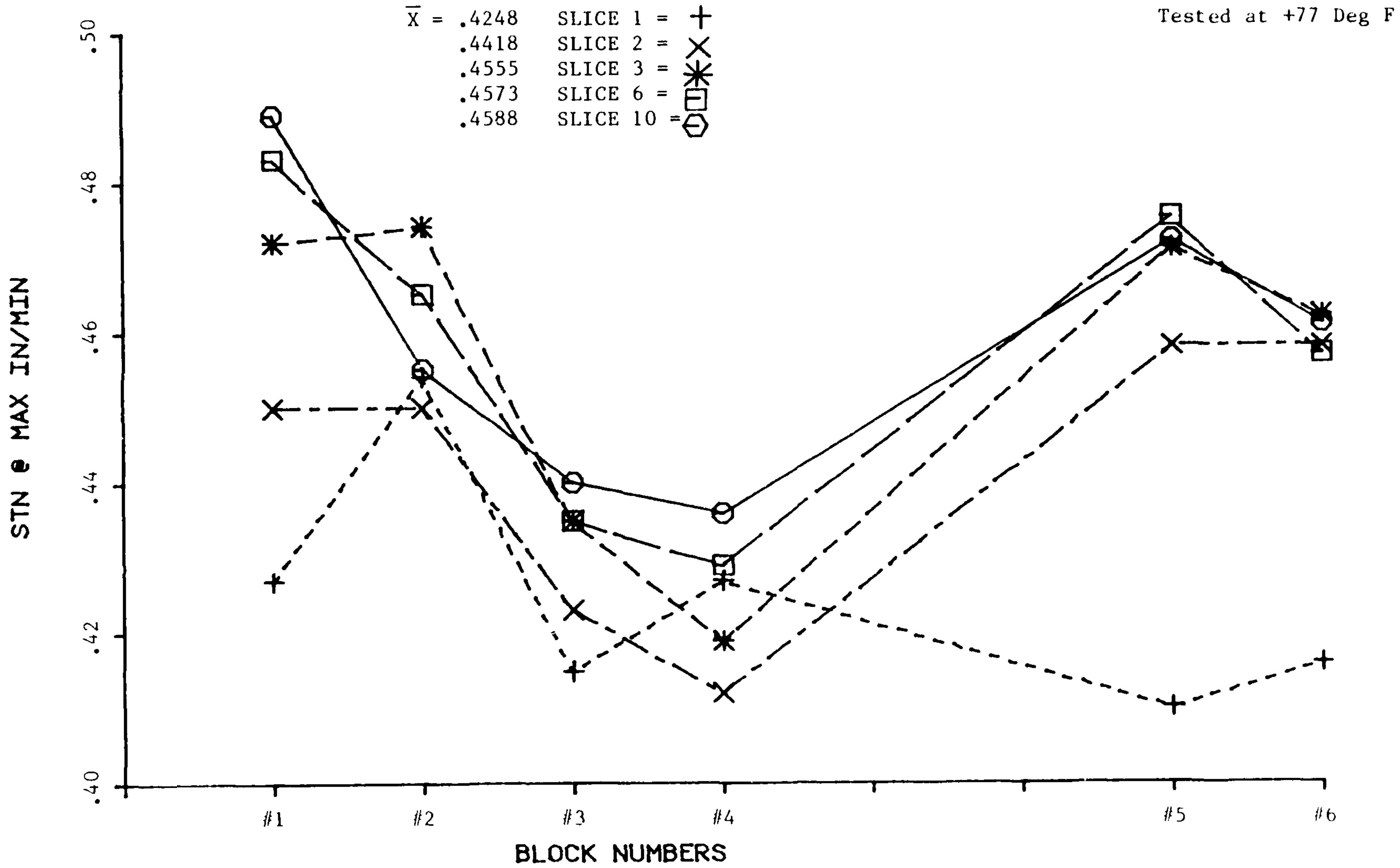
UNCONDITIONED ANY (INNER) BLOCK 5

SLICE	MAXIMUM STRESS	STRAIN @ STRESS	STRESS @ RUPTURE	STRAIN @ RUPTURE	MODULUS
1	127.1	.654	117.9	.777	596
2	128.1	.665	119.1	.783	626
3	128.2	.671	121.5	.752	542
6	122.3	.690	114.7	.791	525
10	117.3	.741	107.4	.902	554
			BLOCK 6		
1	120.7	.651	112.6	.777	602
2	123.2	.676	115.1	.797	583
3	122.1	.672	109.6	.828	490
6	121.3	.701	117.6	.769	523
10	119.1	.739	107.6	.877	501



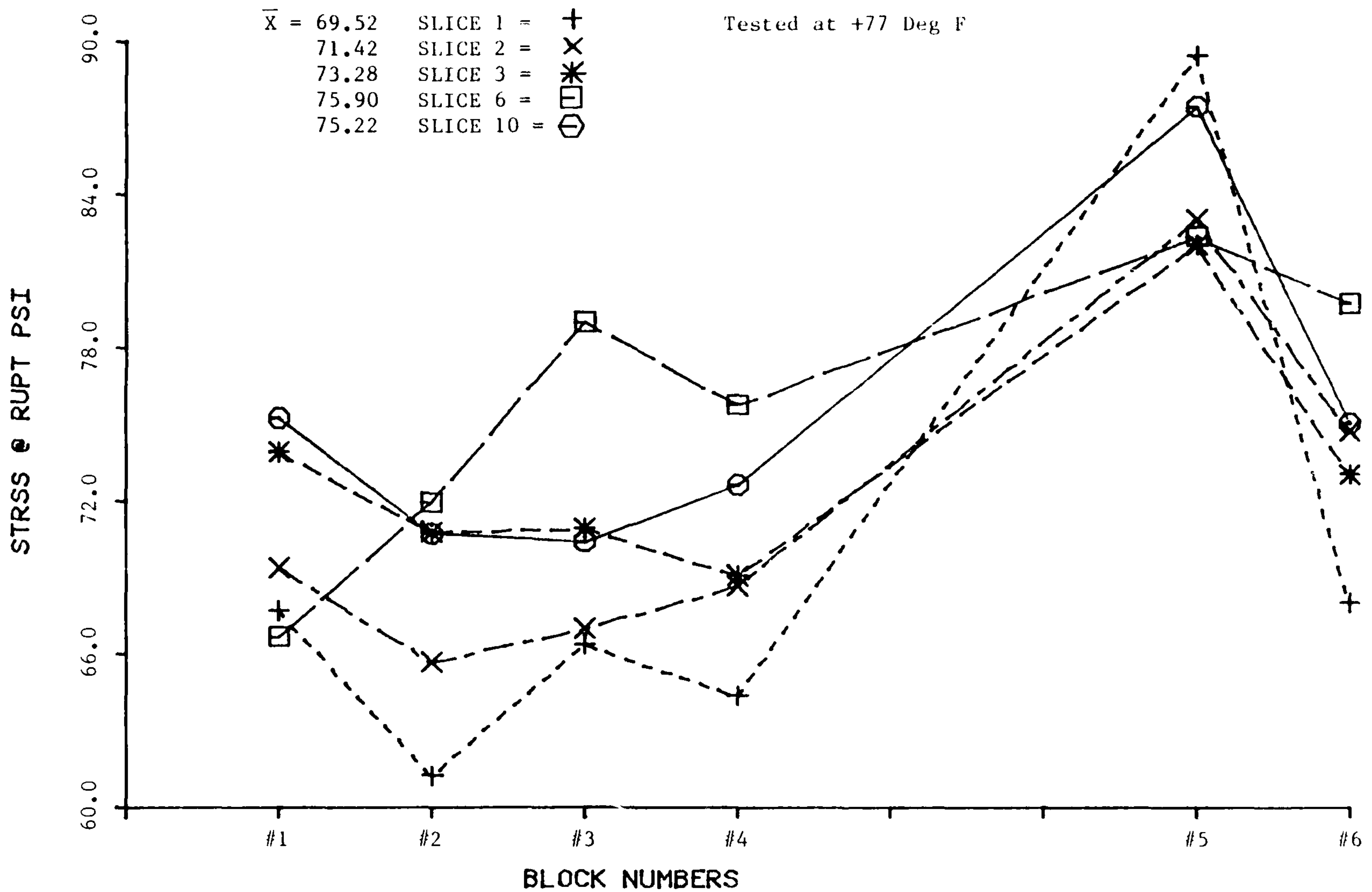
MINITHINS, MSN=0022687, OUTER, BLOCKS 1, 2, 3, 4 CONDIT, AND BLOCKS 5, 6 UNCOND.

FIGURE 39



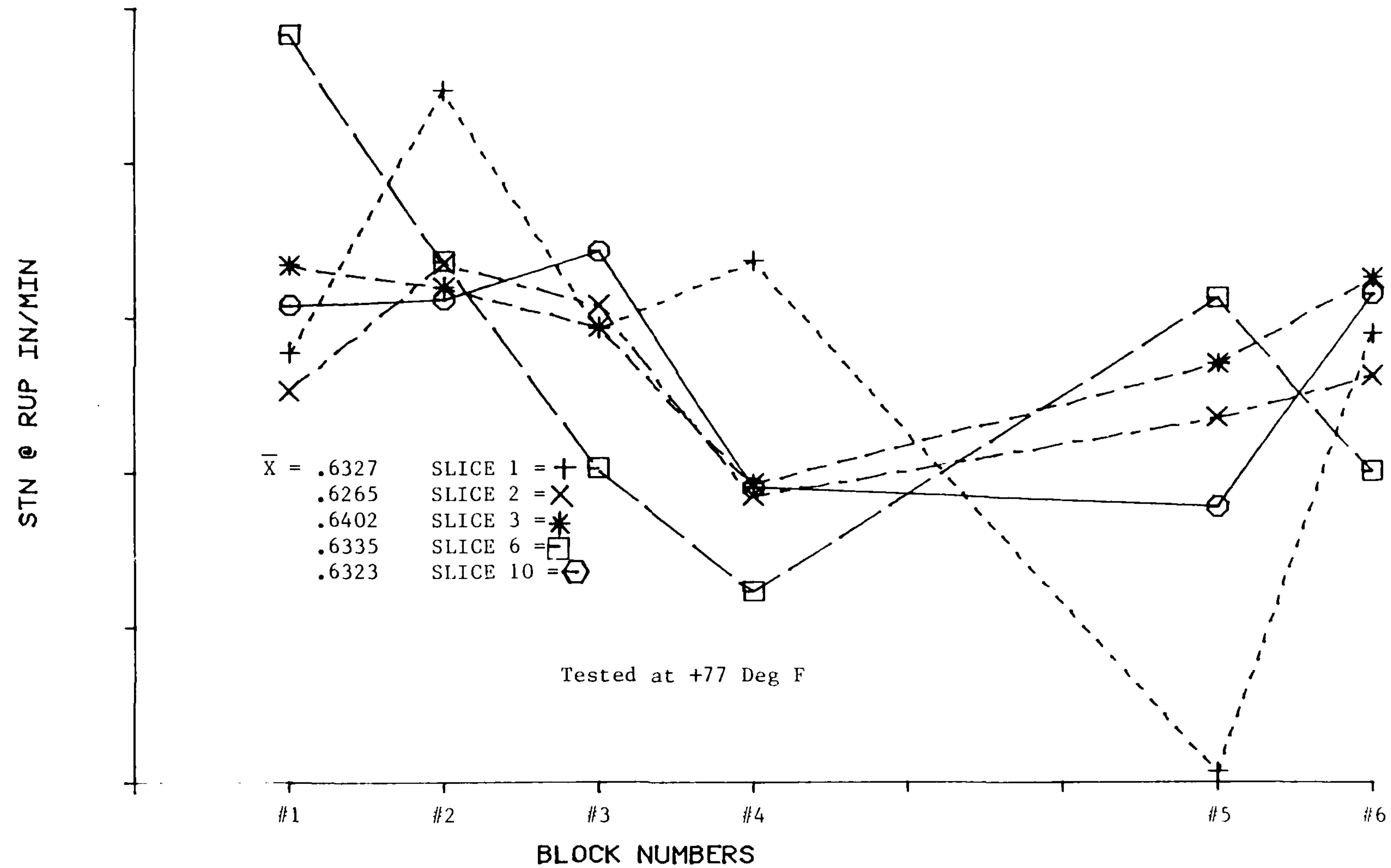
MINITHINS,MSN=0022687,OUTER,BLOCKS 1,2,3,4 CONDIT, AND BLOCKS 5,6 UNCOND

FIGURE 40



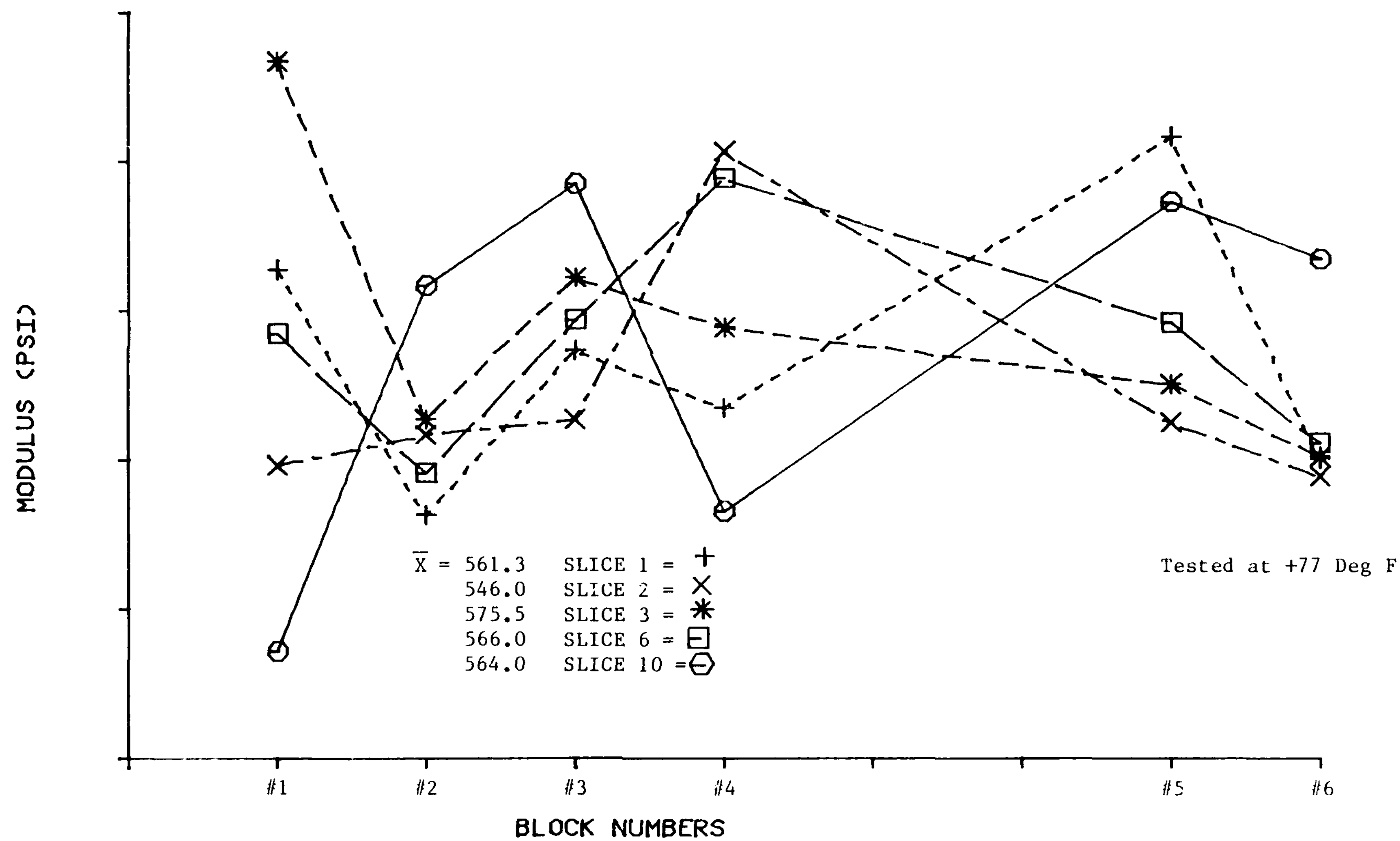
MINITHINS, MSN=0022687, OUTER, BLOCKS 1, 2, 3, 4 CONDIT, AND BLOCKS 5, 6 UNCOND

FIGURE 41



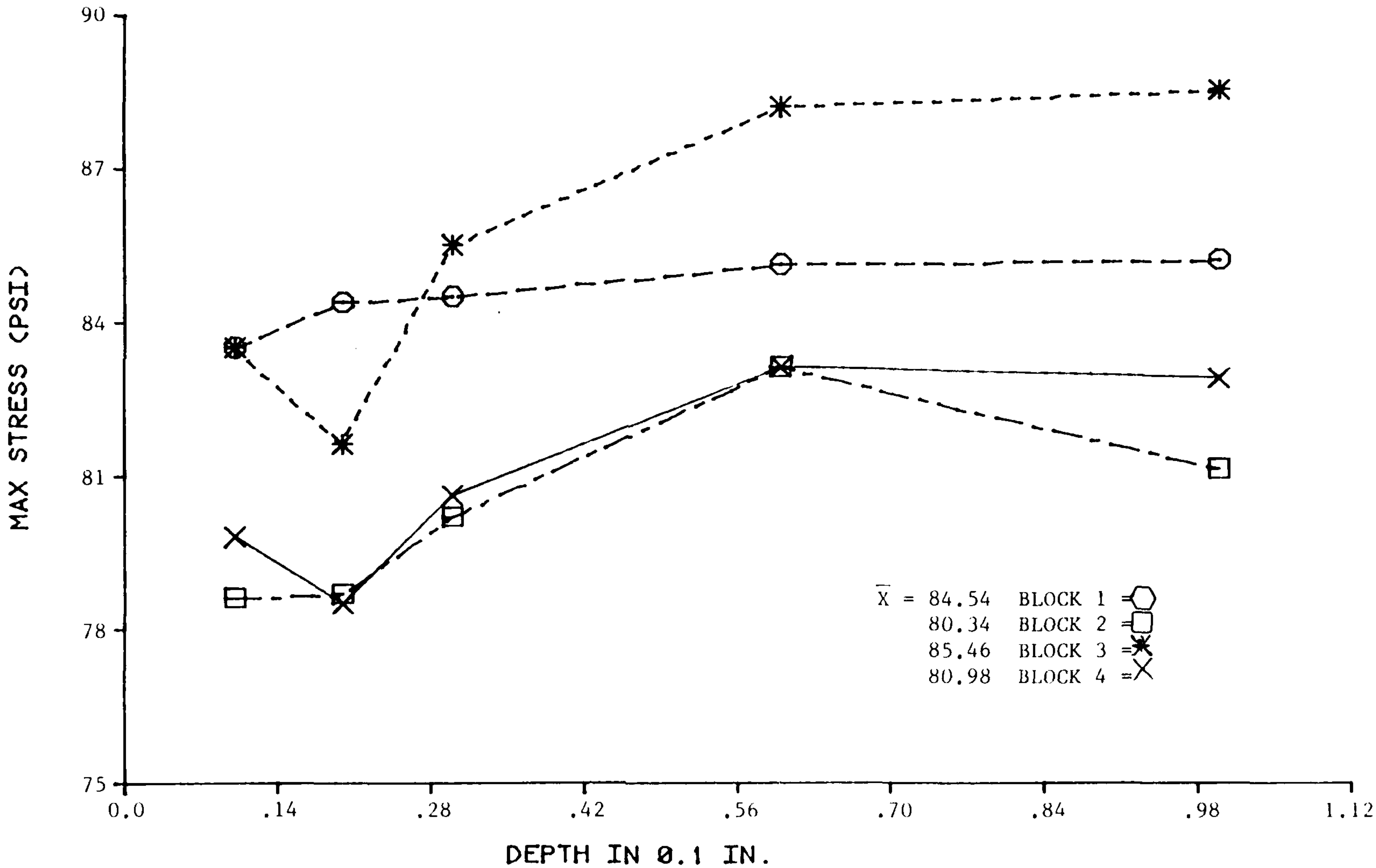
MINITHINS,MSN=0022687,OUTER,BLOCKS 1,2,3,4 CONDIT,AND BLOCKS 5,6 UNCOND

FIGURE 42



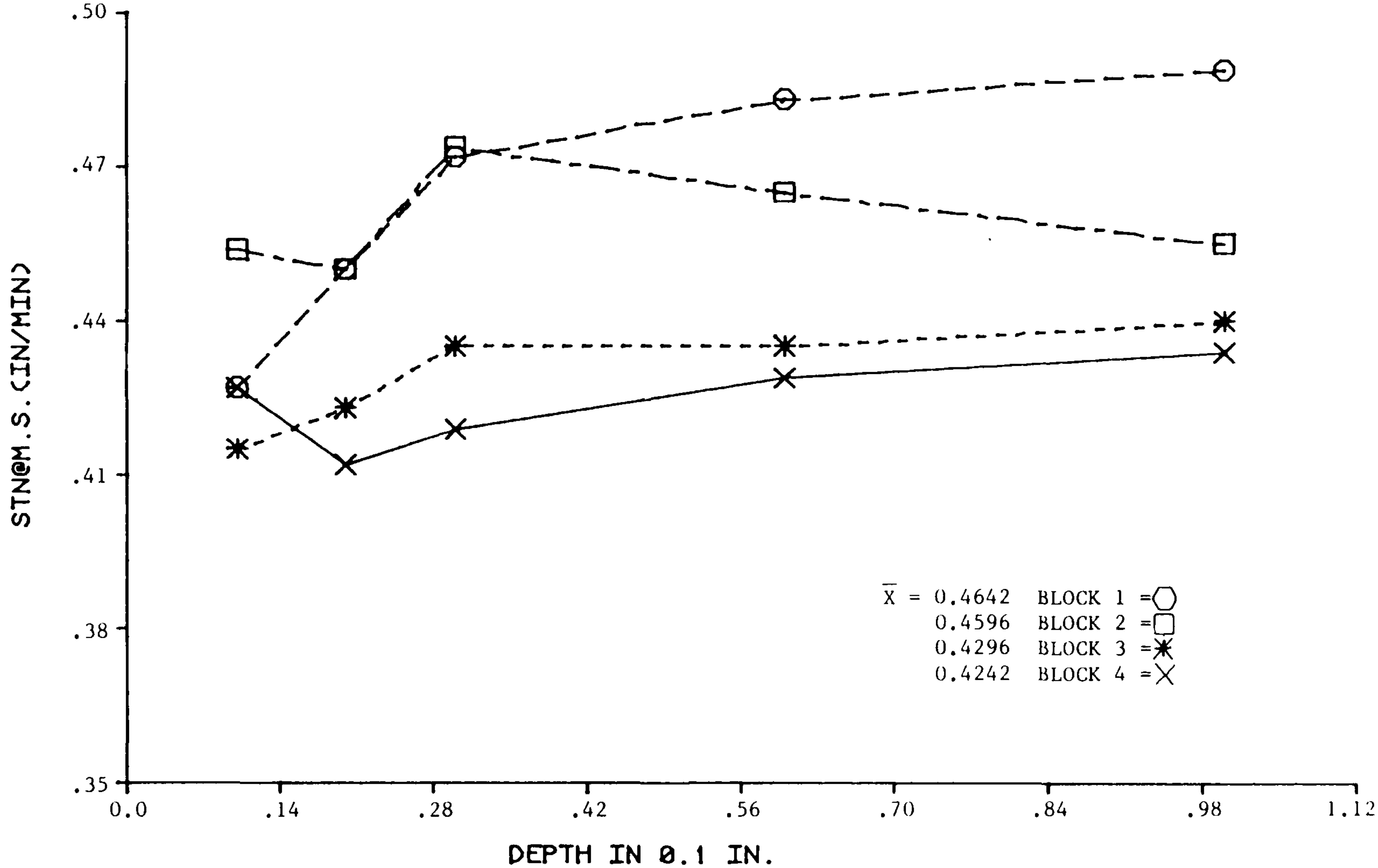
MINITHINS, MSN=0022687, OUTER, BLOCKS 1,2,3,4 CONDIT, AND BLOCKS 5,6 UNCOND

FIGURE 43



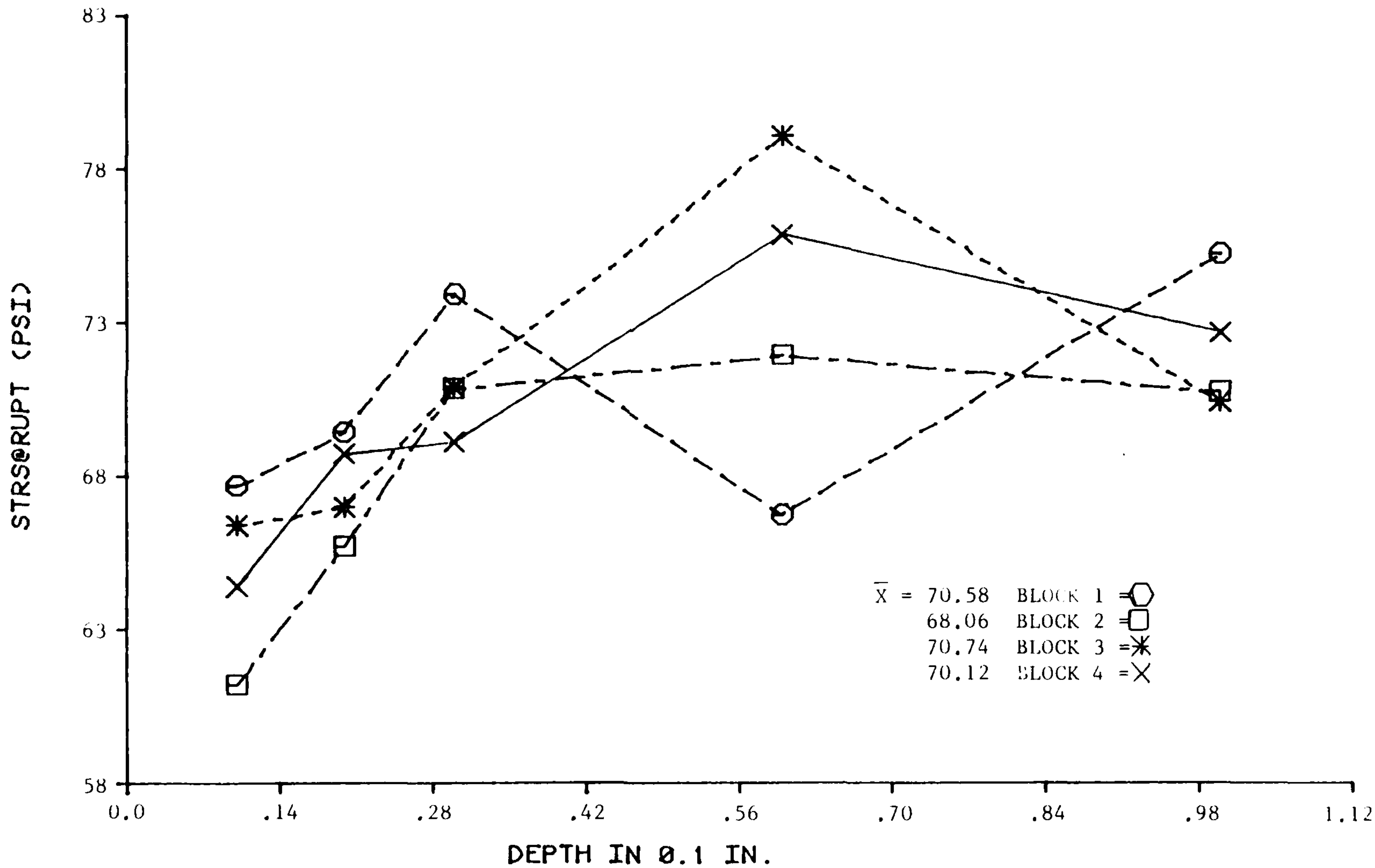
OUTER,COND. PROPELLANT, MINITHIN MAX STRESS VALUES COMPARED 4 BLOCKS

FIGURE 44



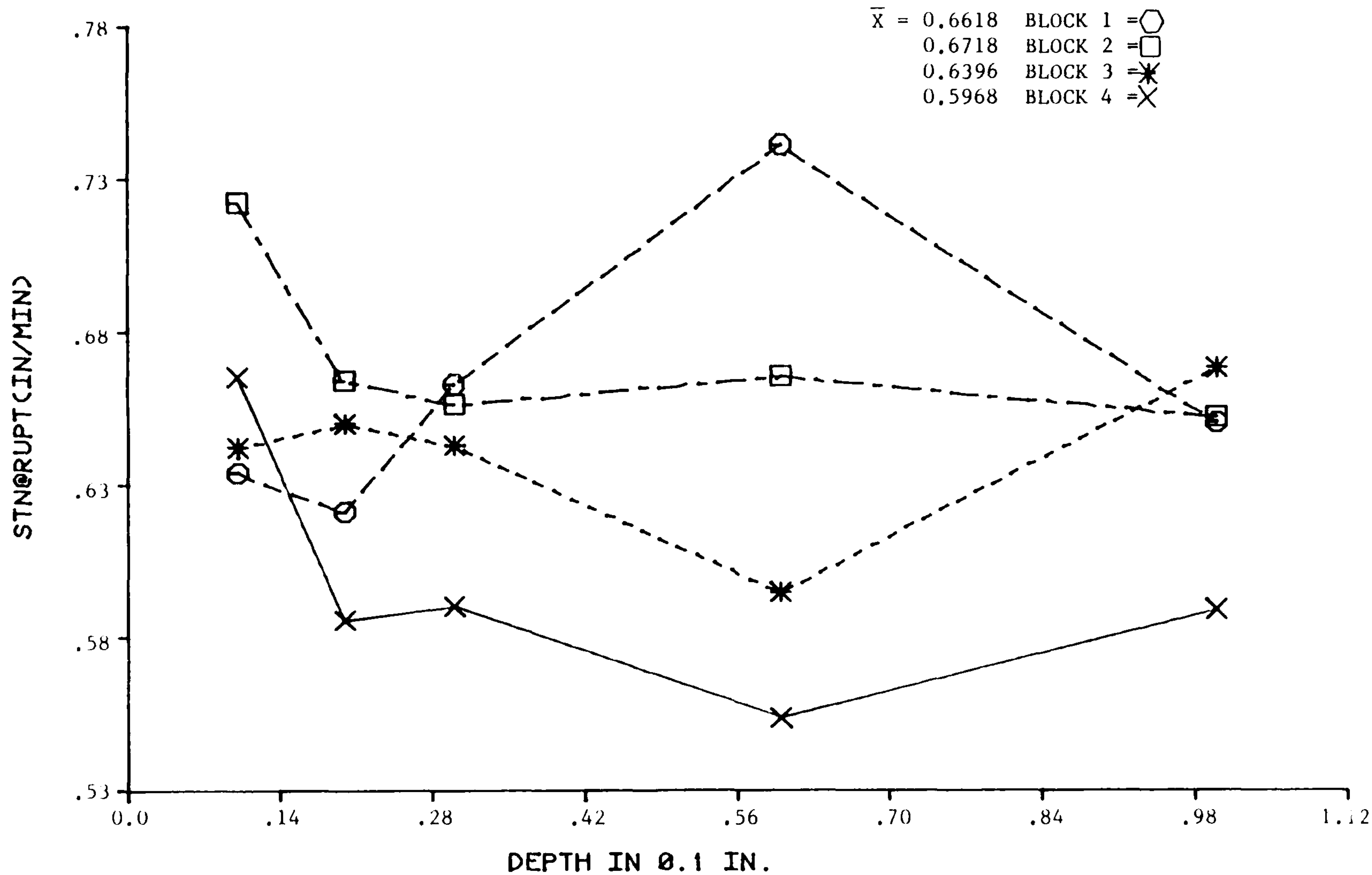
OUTER,COND. PROPELLANT, MINITHIN STRN @ MAX STRS. VALUES COMPARED 4 BLKS

FIGURE 45



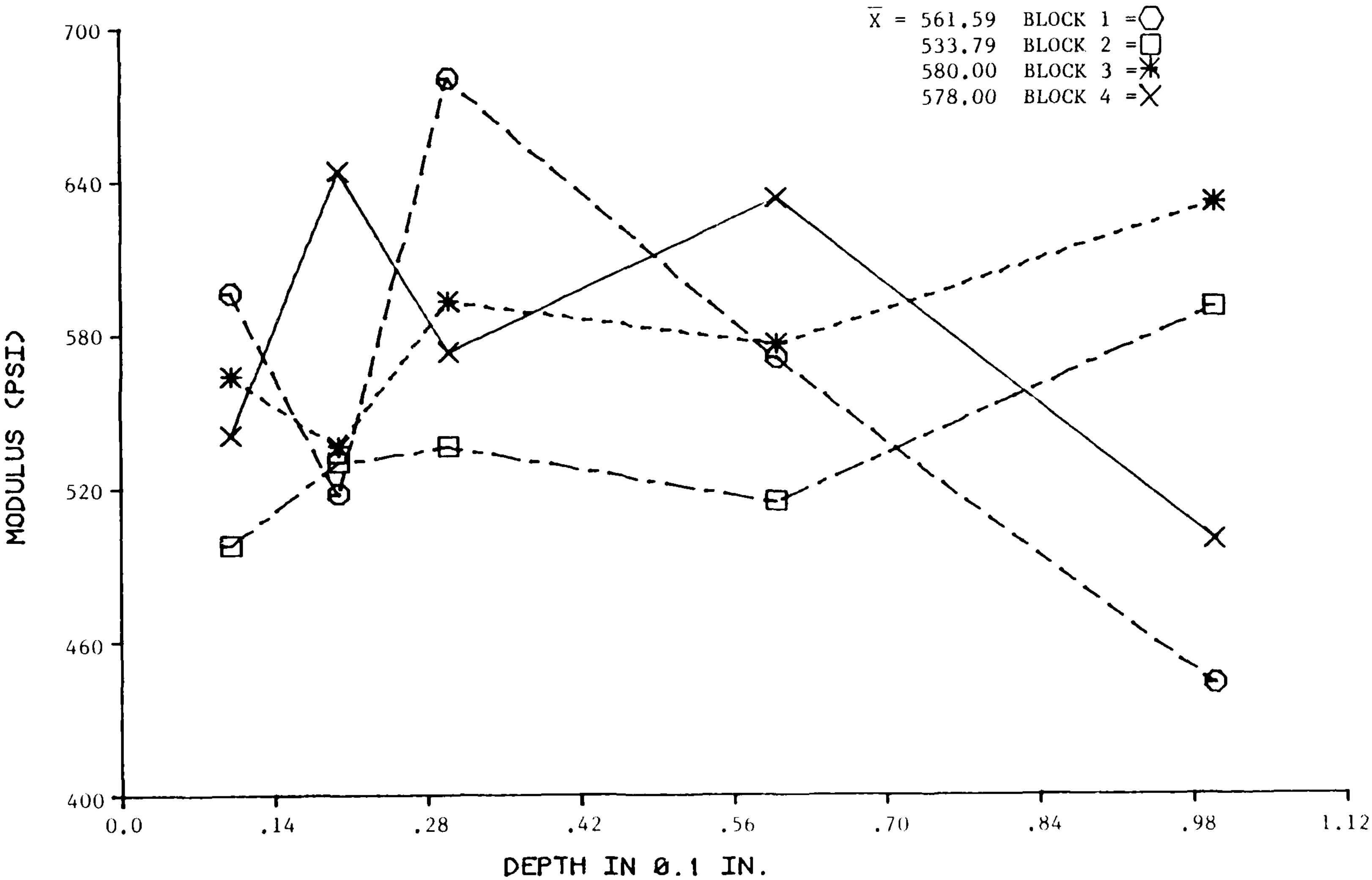
OUTER, COND. PROPELLANT, MINITHIN STRS. AT RUPT. VALUES COMPARED 4 BLOCKS

FIGURE 46



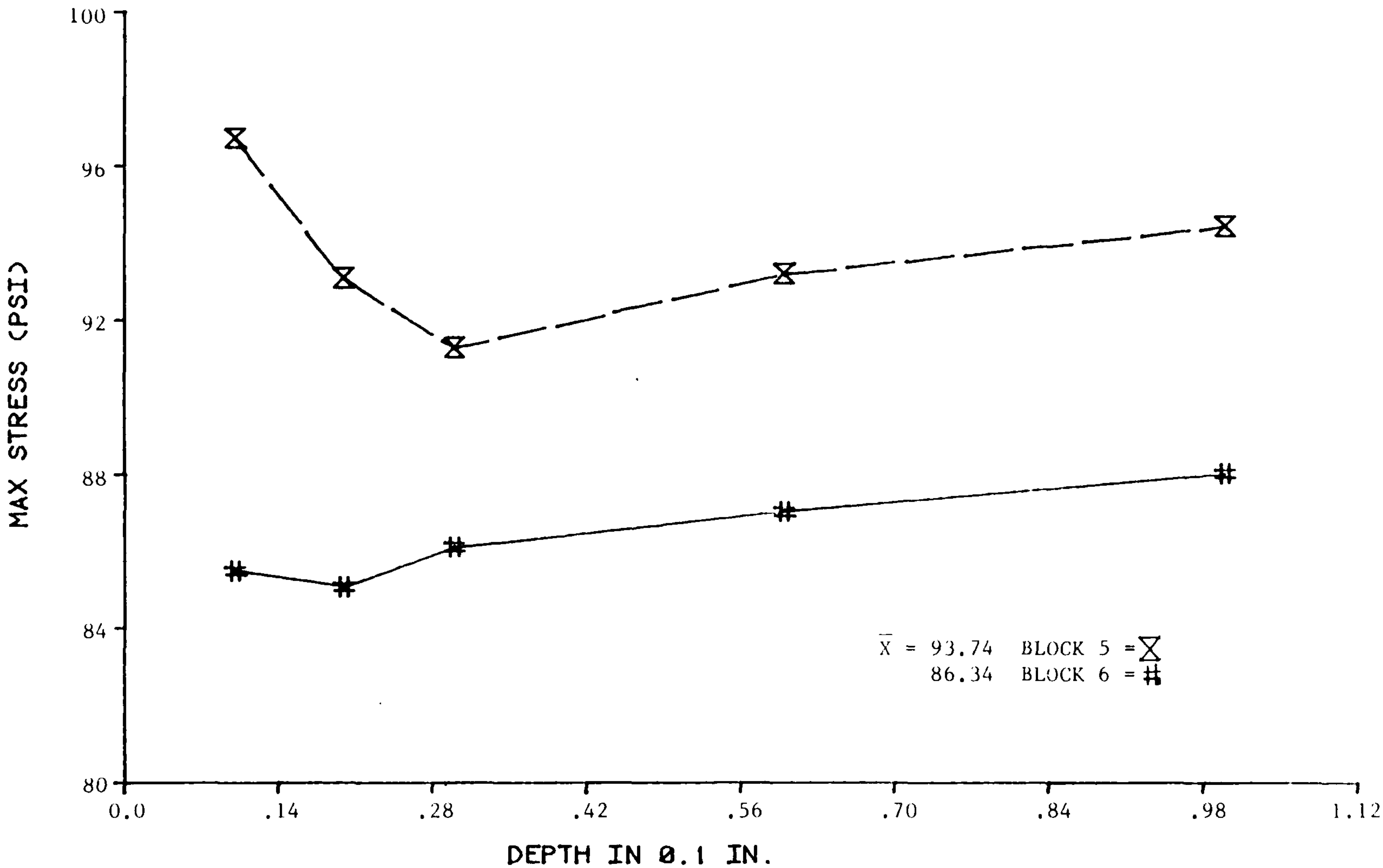
OUTER,COND. PROPELLANT, MINITHIN STRN AT RUPT. VALUES COMPARED 4 BLOCKS

FIGURE 47



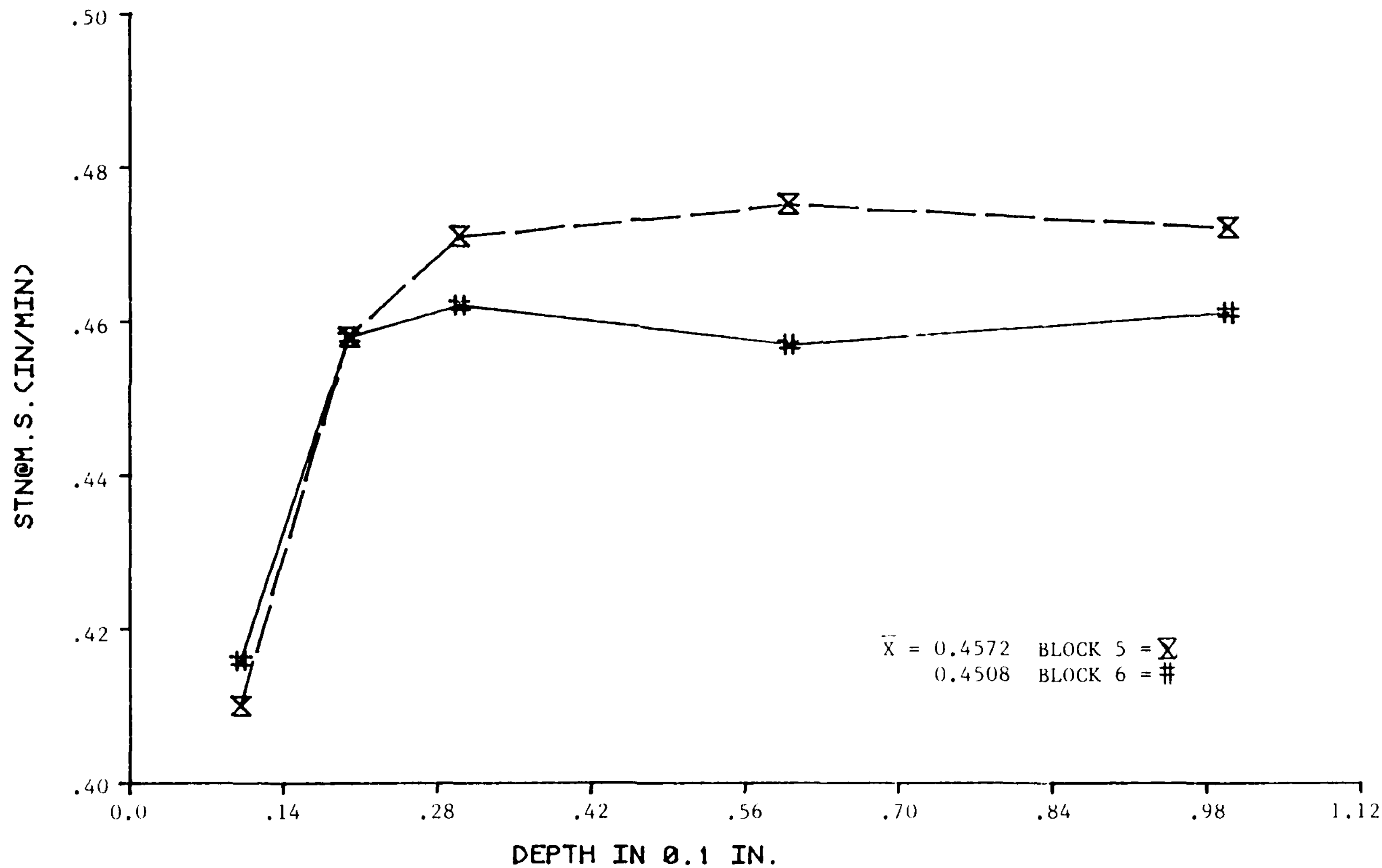
OUTER, COND. PROPELLANT, MINITHIN MODULUS VALUES COMPARED 4 BLOCKS

FIGURE 48



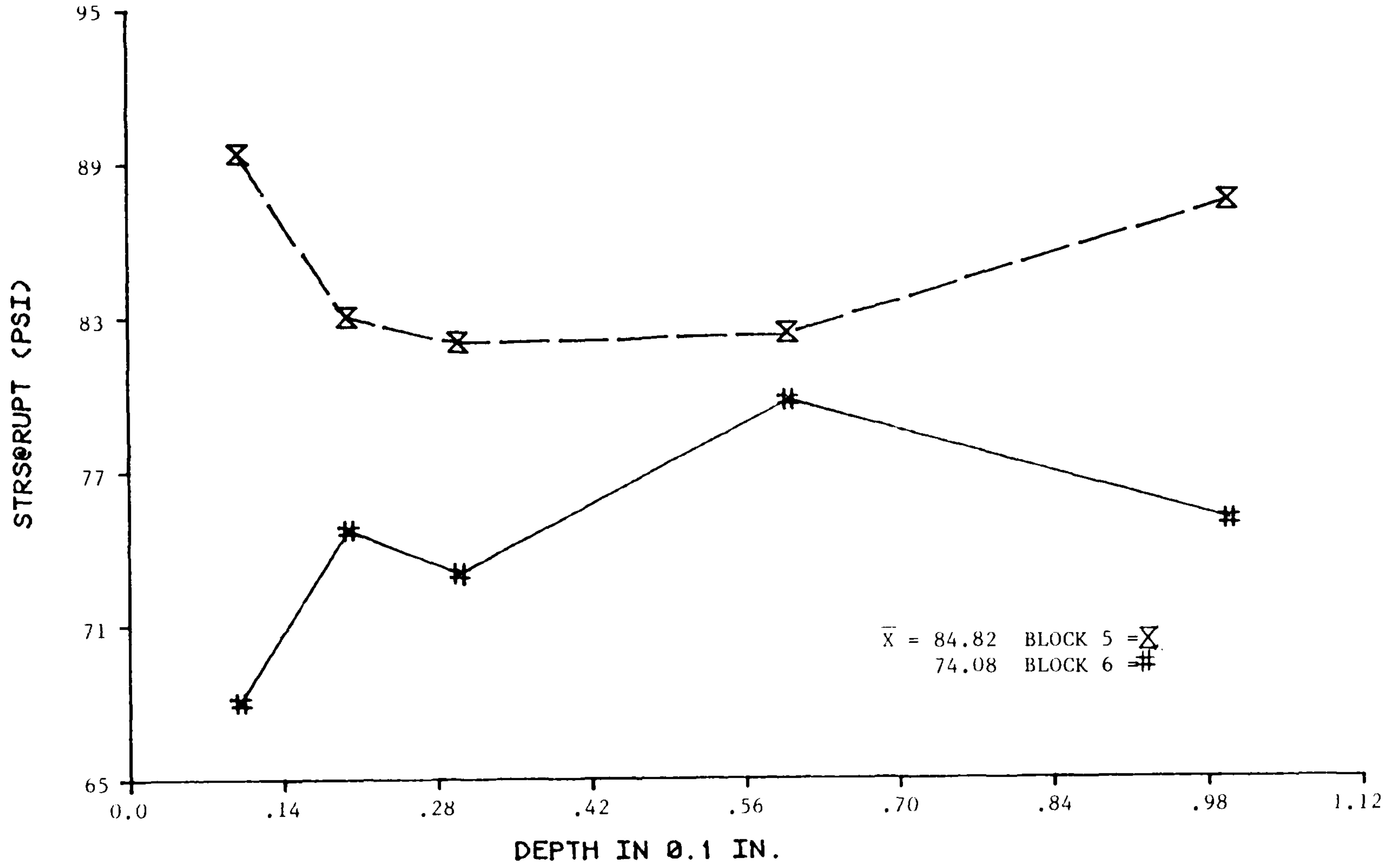
OUTER,UNCOND. PROPELLANT, MINITHIN MAX STRESS VALUES COMPARED 2 BLOCKS

FIGURE 49



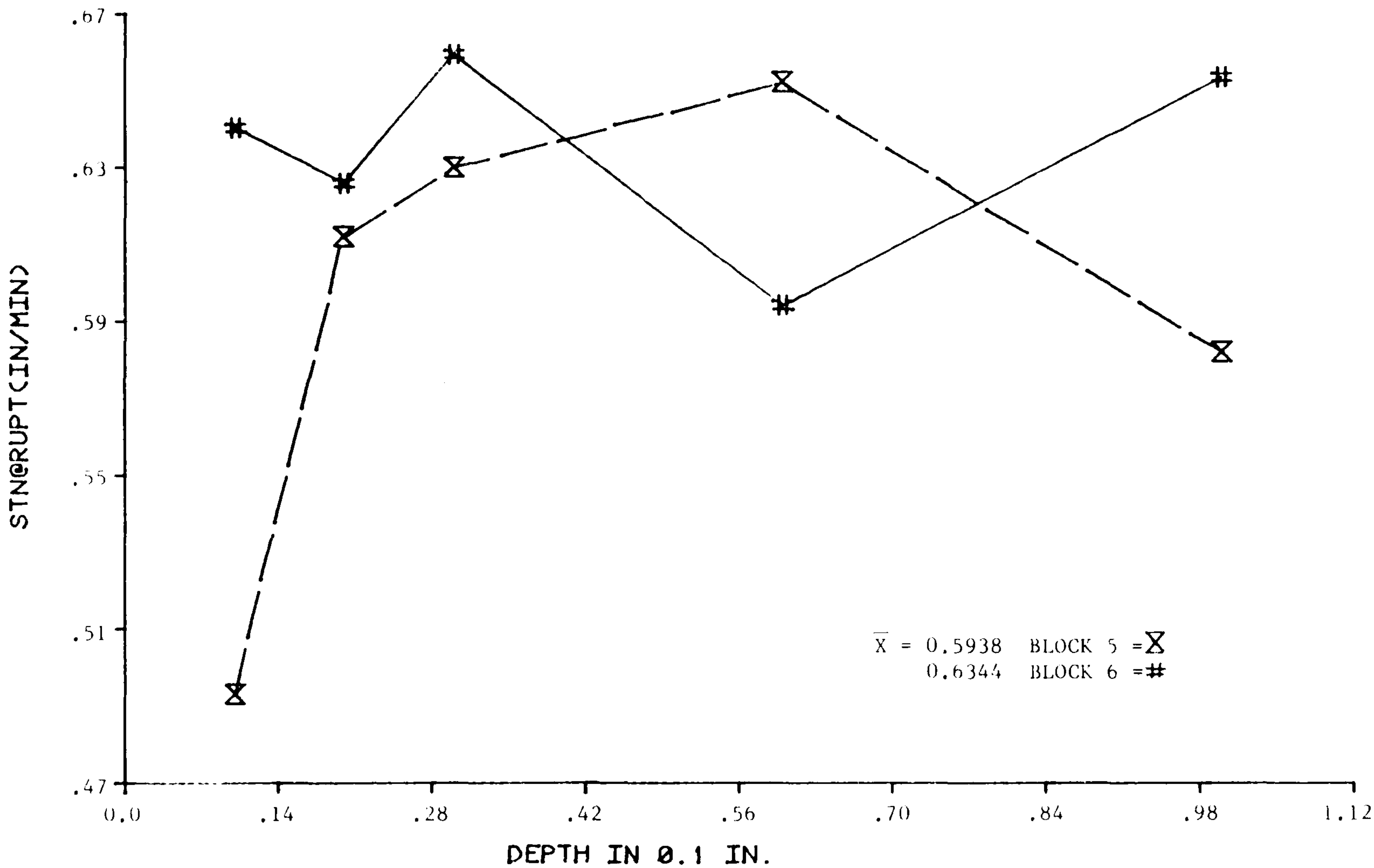
OUTER,UNCOND. PROPELLANT, MINITHIN STRN @ MAX STRS. VALUES COMPRD. 2 BLK

FIGURE 50



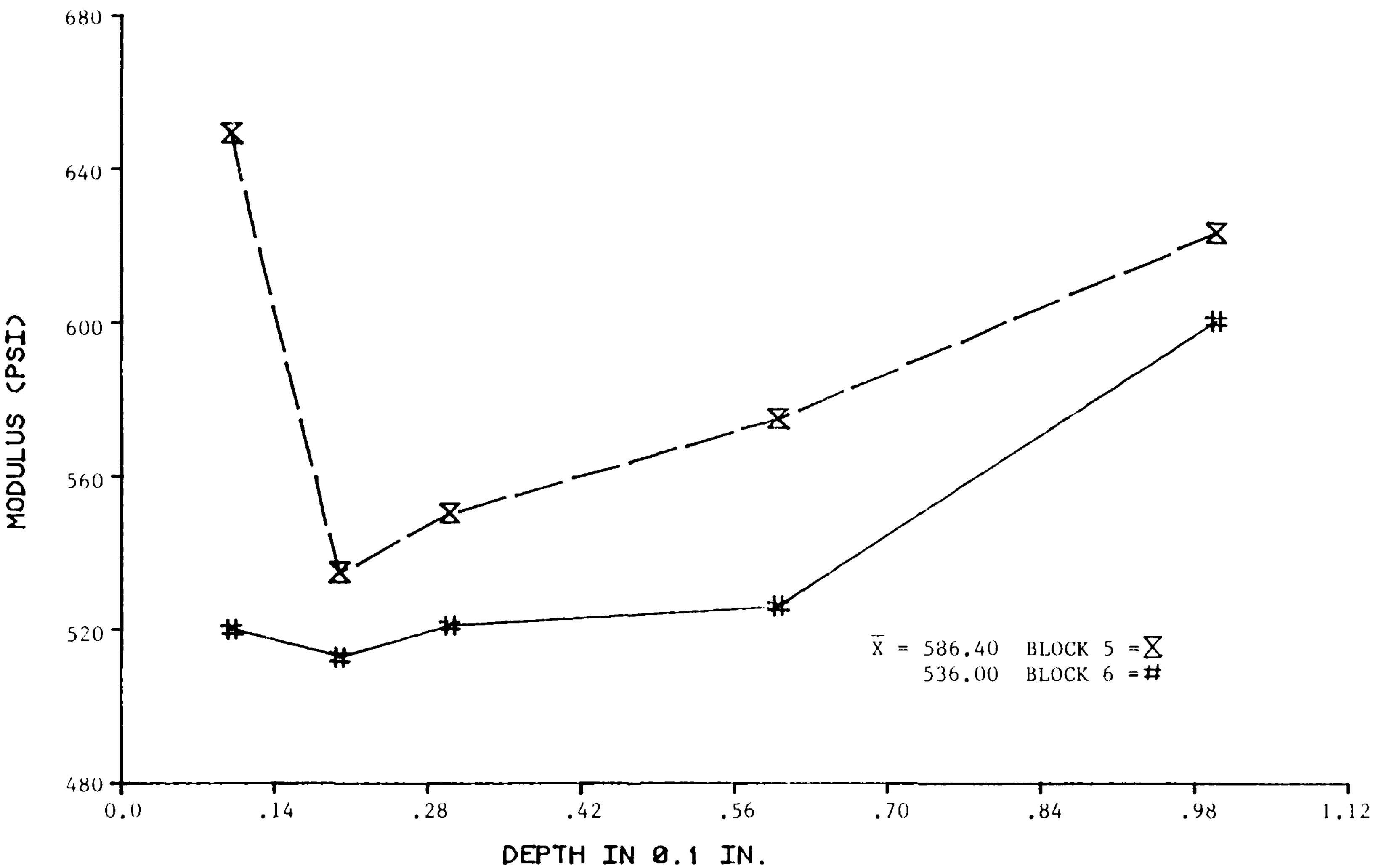
OUTER, UNCOND. PROPELLANT, MINITHIN STRS @ RUPT. VALUES COMPARED 2 BLOCKS

FIGURE 51



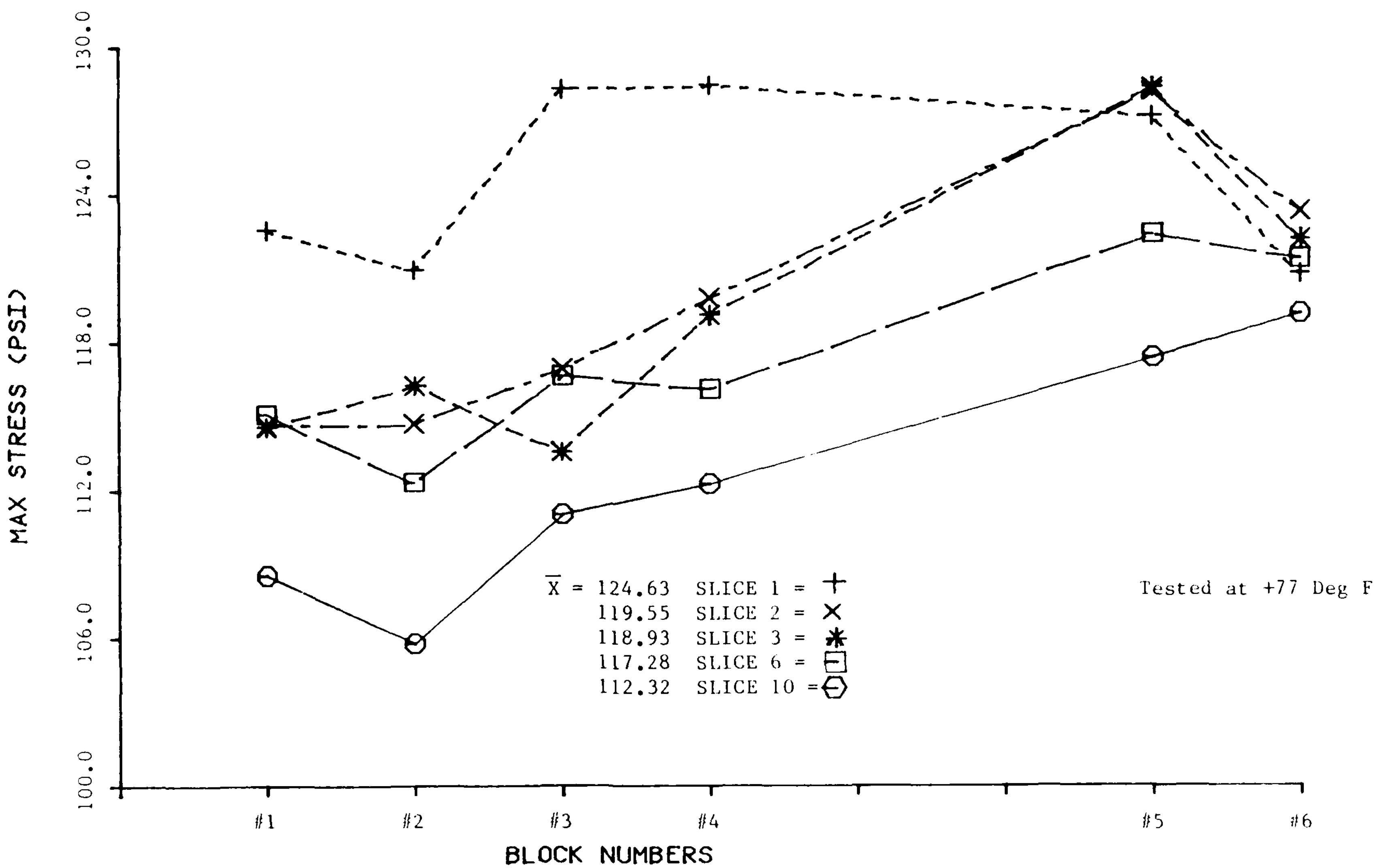
OUTER, UNCOND. PROPELLANT, MINITHIN STRN @ RUPT. VALUES COMPARED 2 BLOCKS

FIGURE 52



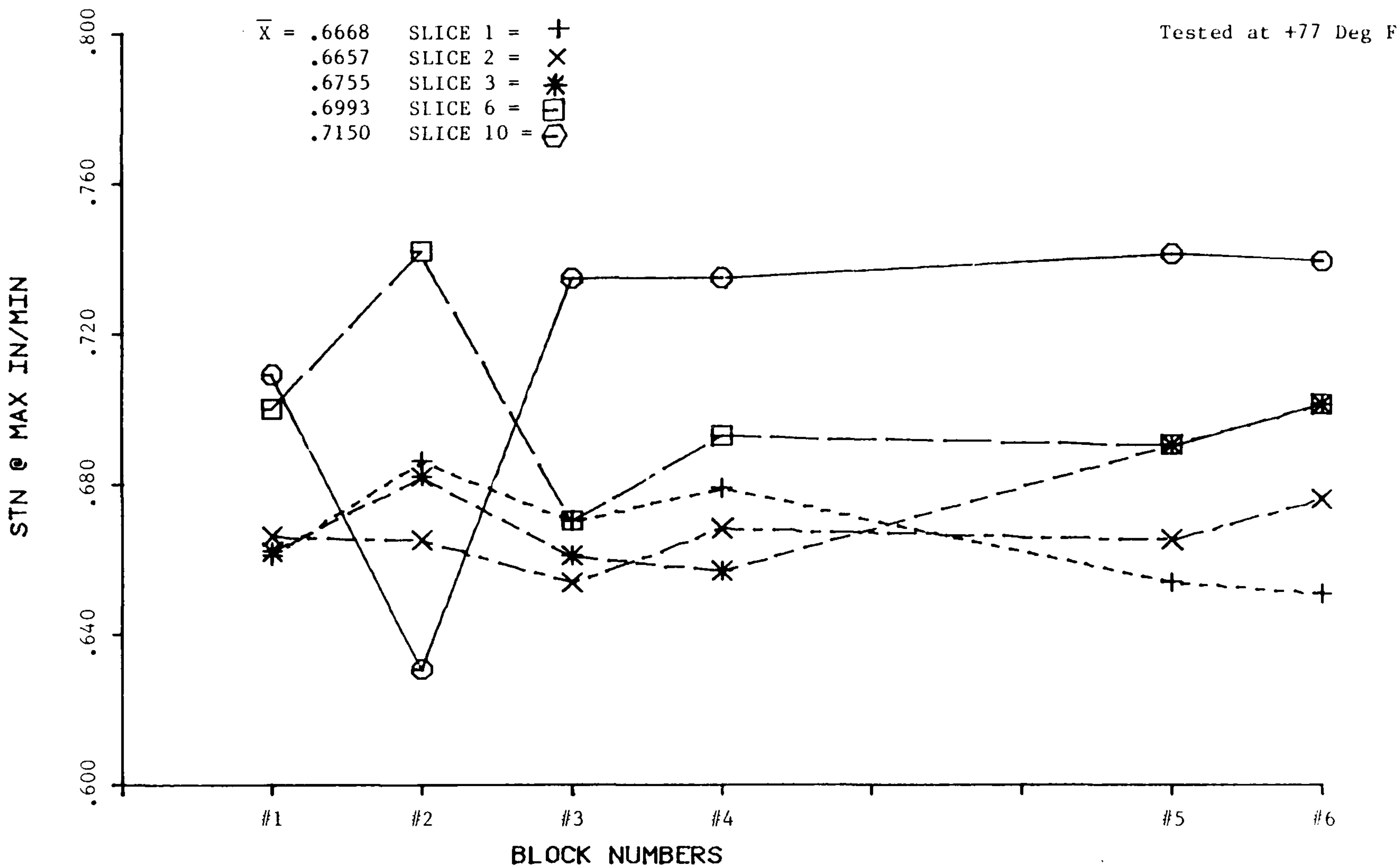
OUTER, UNCOND. PROPELLANT, MINITHIN MODULUS VALUES COMPARED 2 BLOCKS

FIGURE 53



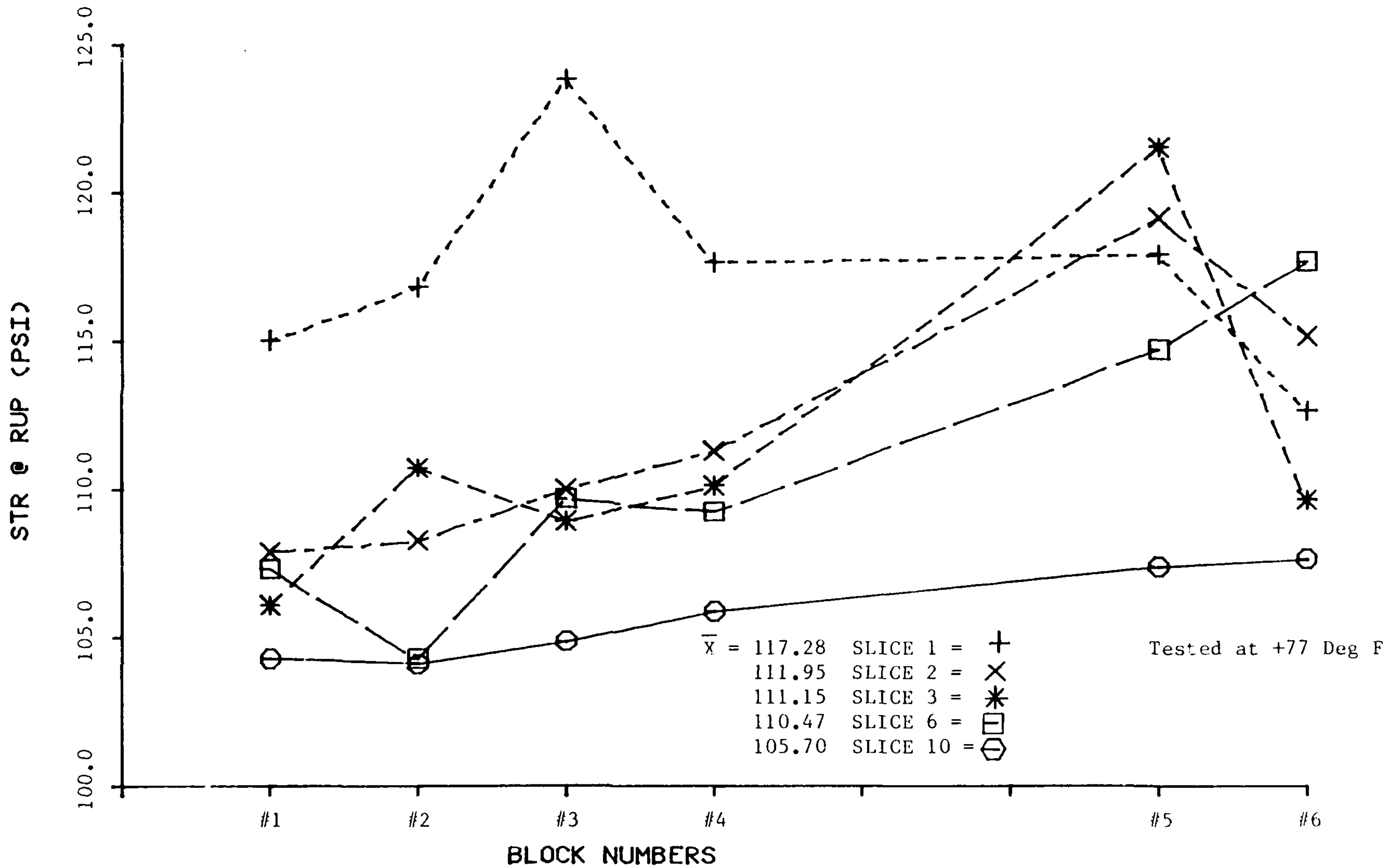
MINITHINS, MSN=0022687, INNER, BLOCKS 1, 2, 3, 4 CONDIT, AND BLOCKS 5, 6 UNCOND.

FIGURE 54



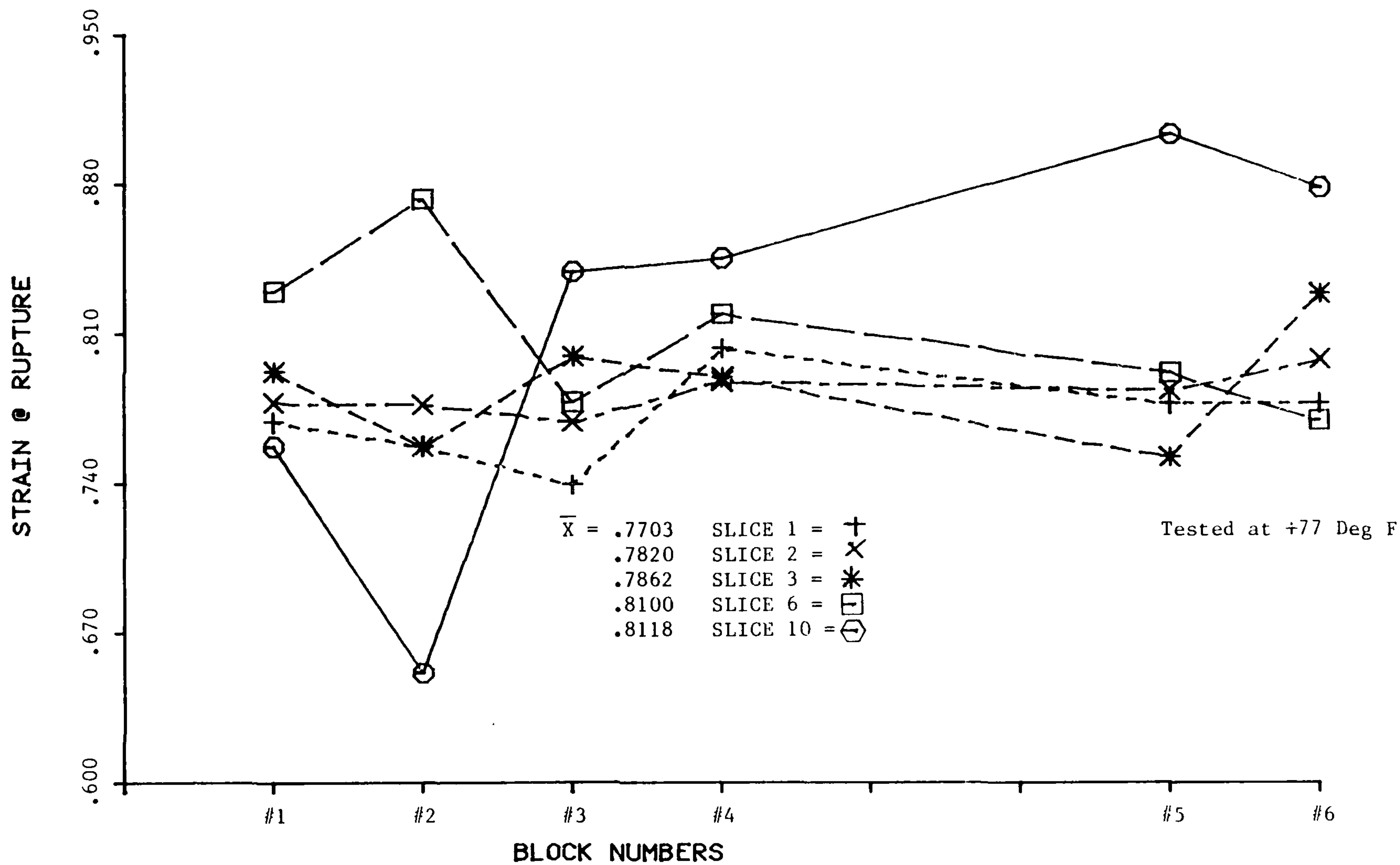
MINITHINS,MSN=0022687,INNER,BLOCKS 1,2,3,4 CONDIT,AND BLOCKS 5,6 UNCOND.

FIGURE 55



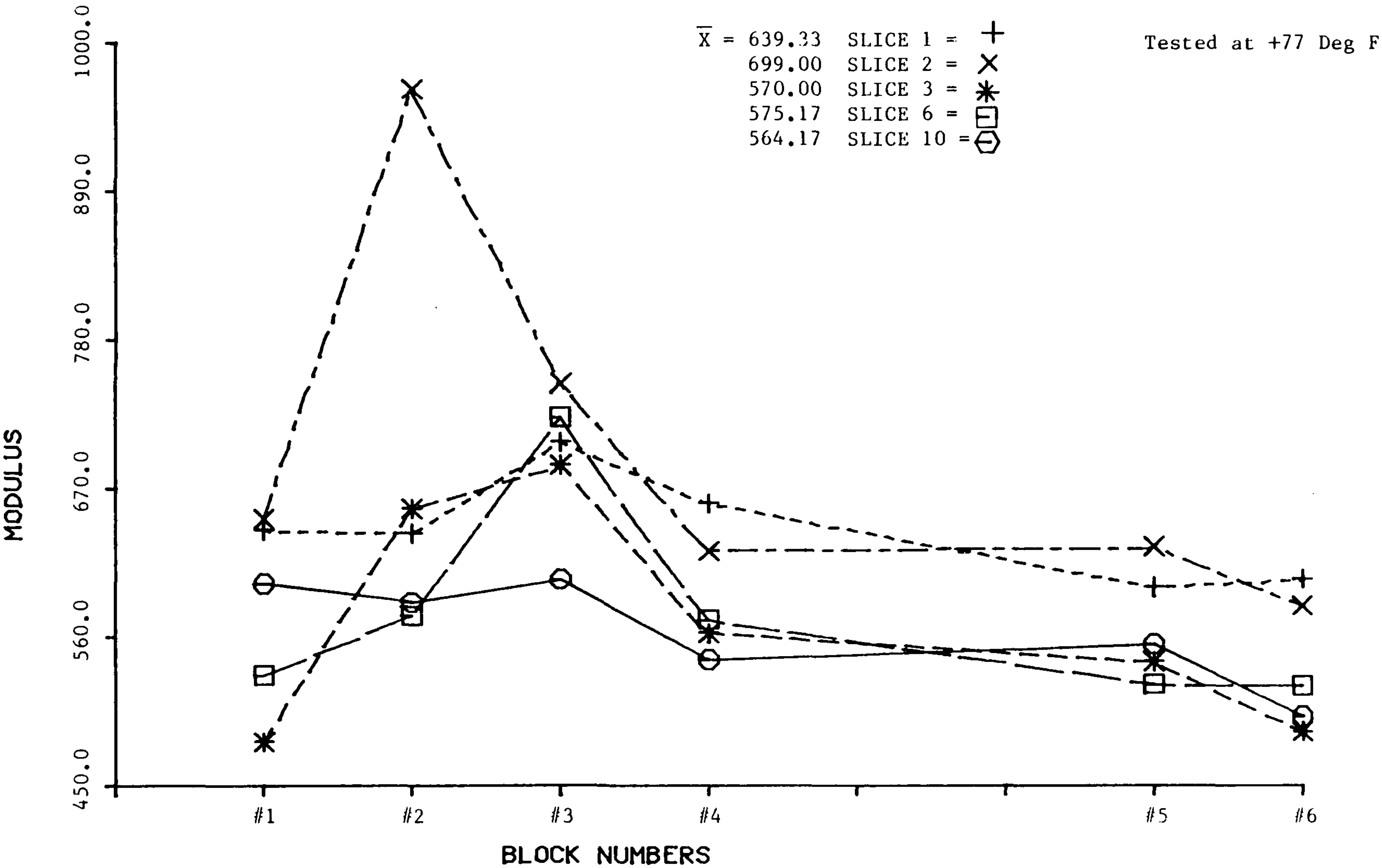
MINITHINS,MSN=0022687,INNER,BLOCKS 1,2,3,4 CONDIT,AND BLOCKS 5,6 UNCOND.

FIGURE 56



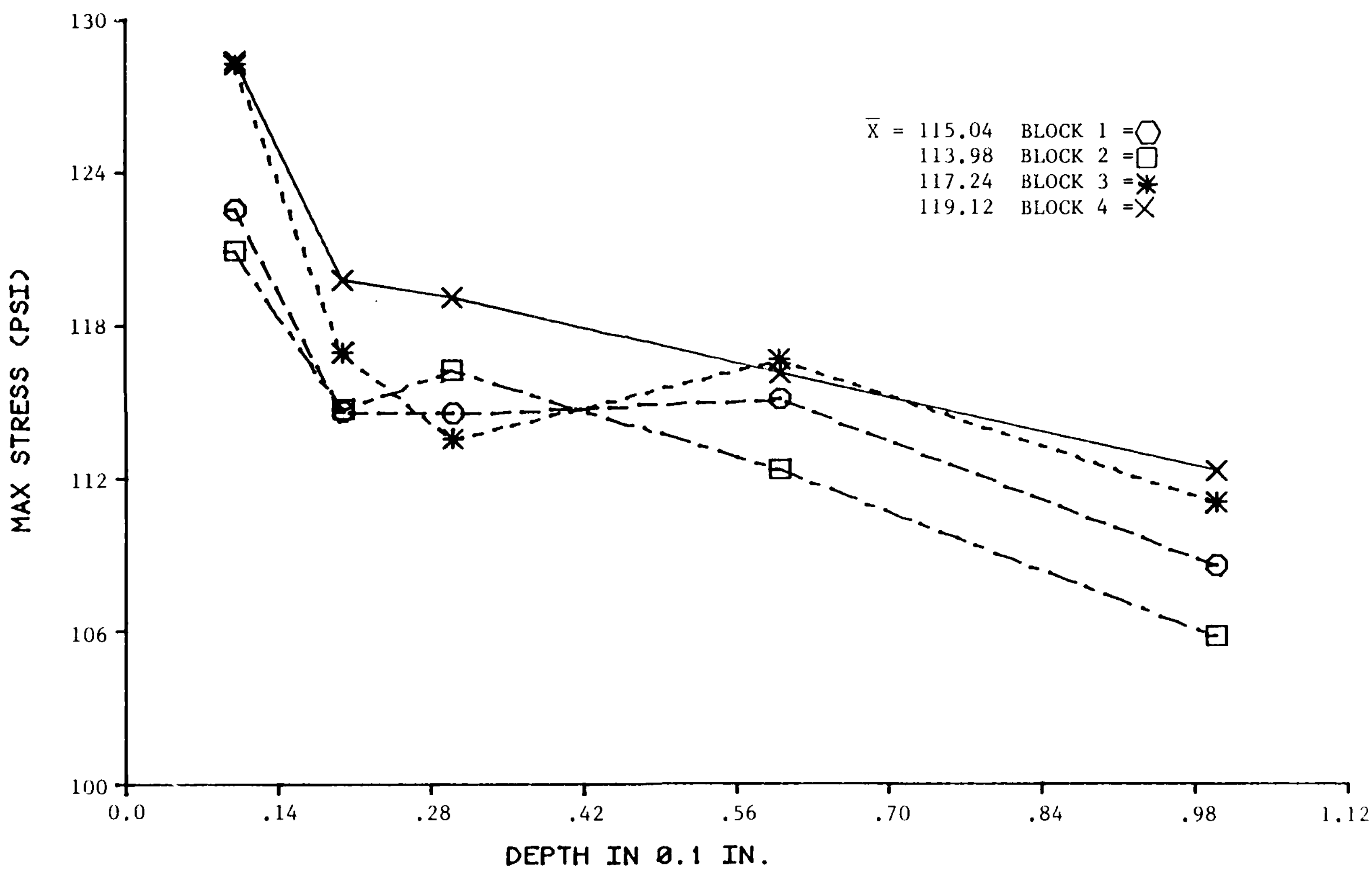
MINITHINS,MDN=0022687,INNER,BLOCKS 1,2,3,4 CONDIT,AND BLOCKS 5,6 UNCOND.

FIGURE 57



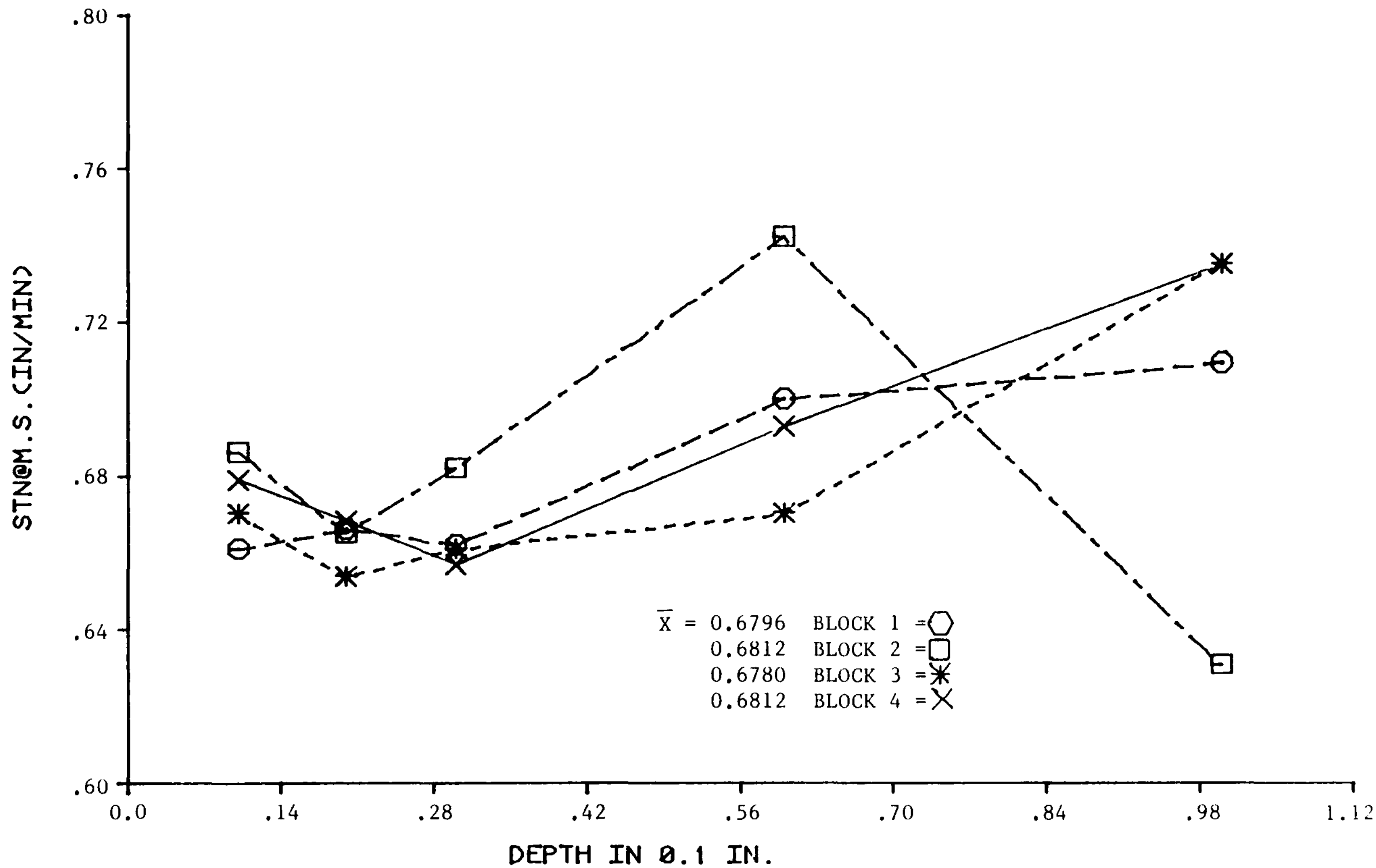
MINITHINS, MSN=0022687, INNER, BLOCKS 1,2,3,4 CONDIT, AND BLOCKS 5,6 UNCOND.

FIGURE 58



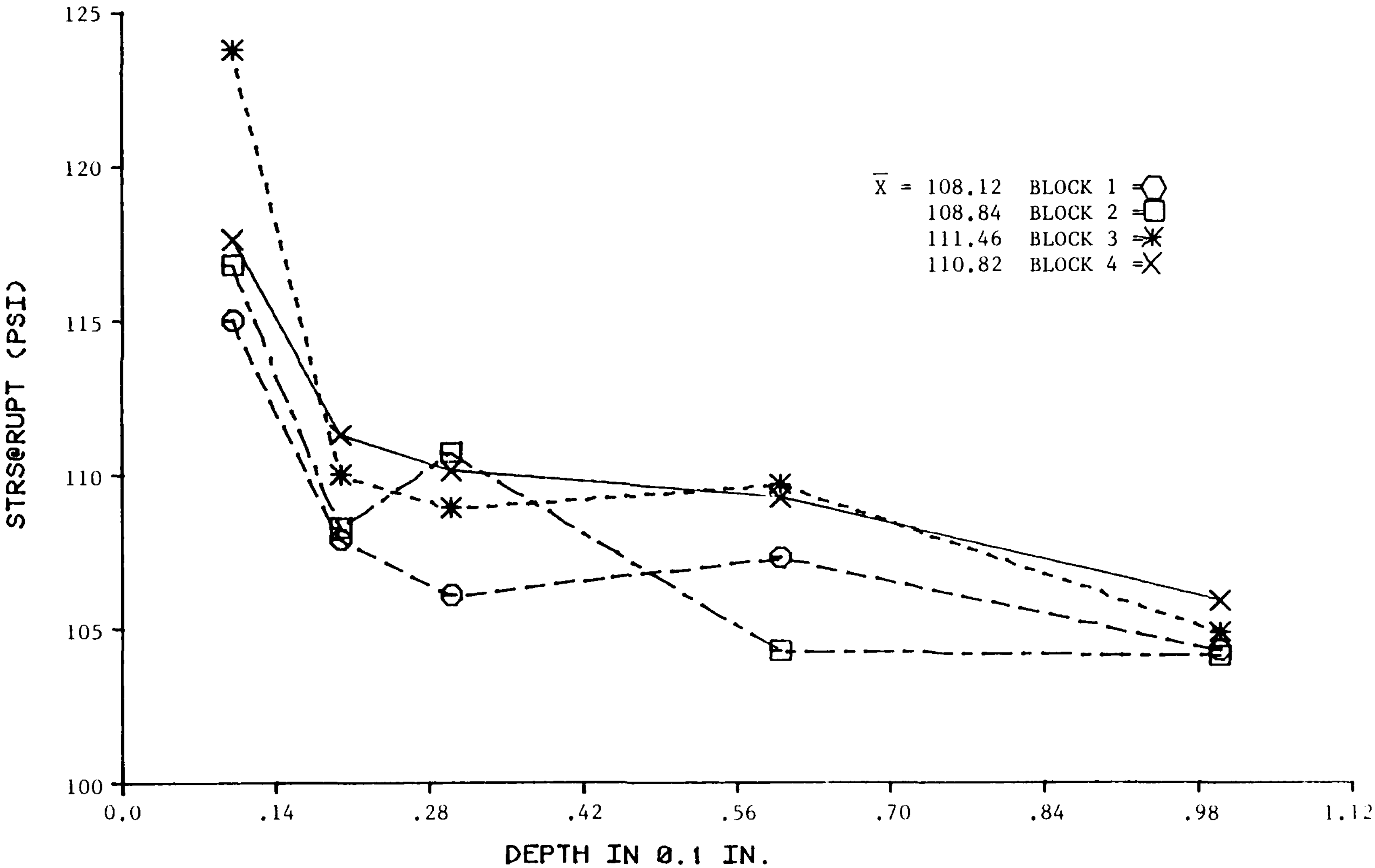
INNER, COND. PROPELLANT, MINITHIN MAX STRESS VALUES COMPARED 4 BLOCKS

FIGURE 59



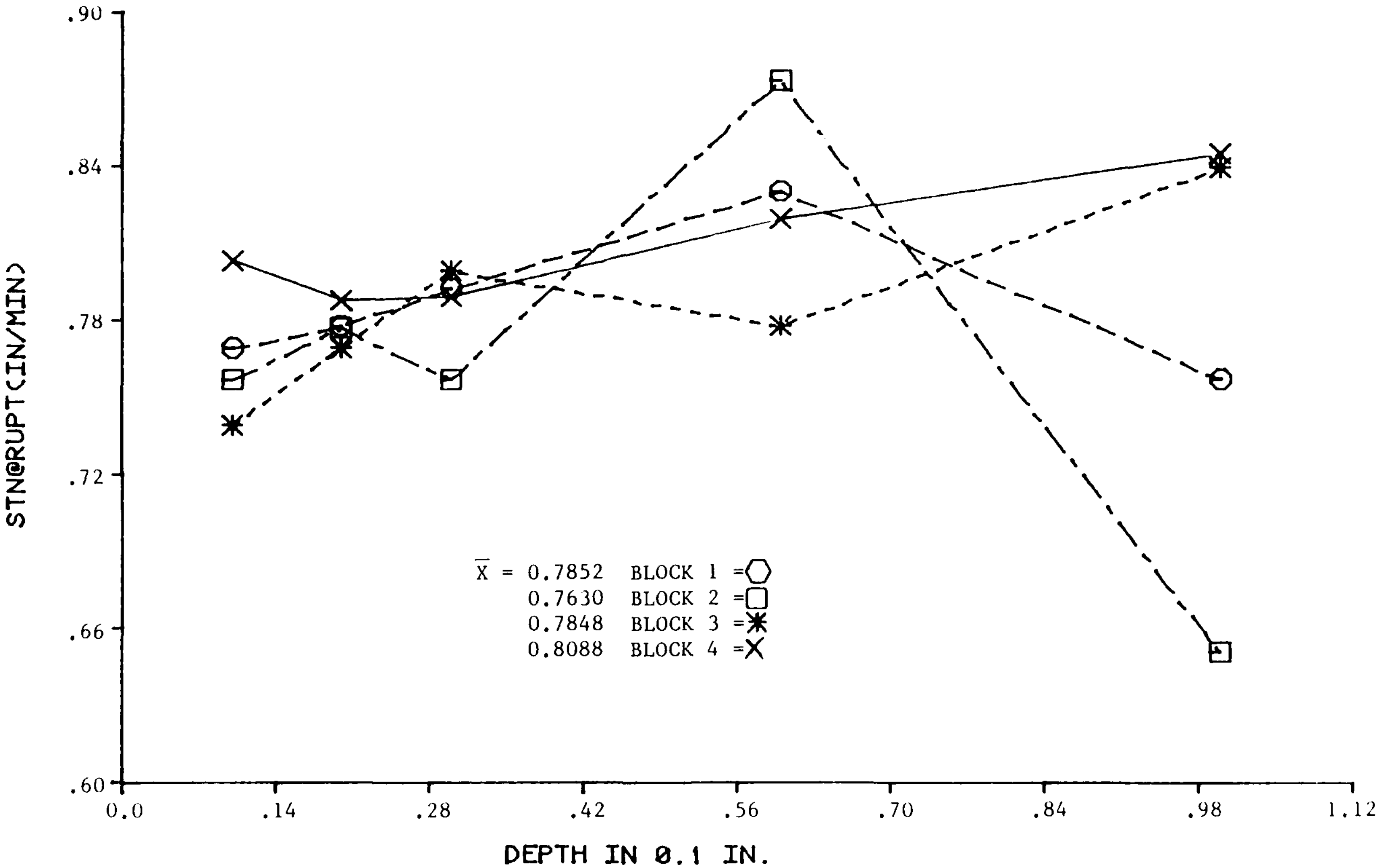
INNER,COND. PROPELLANT, MINITHIN STRN @ MAX STRS. VALUES COMPARED 4 BLKS

FIGURE 60



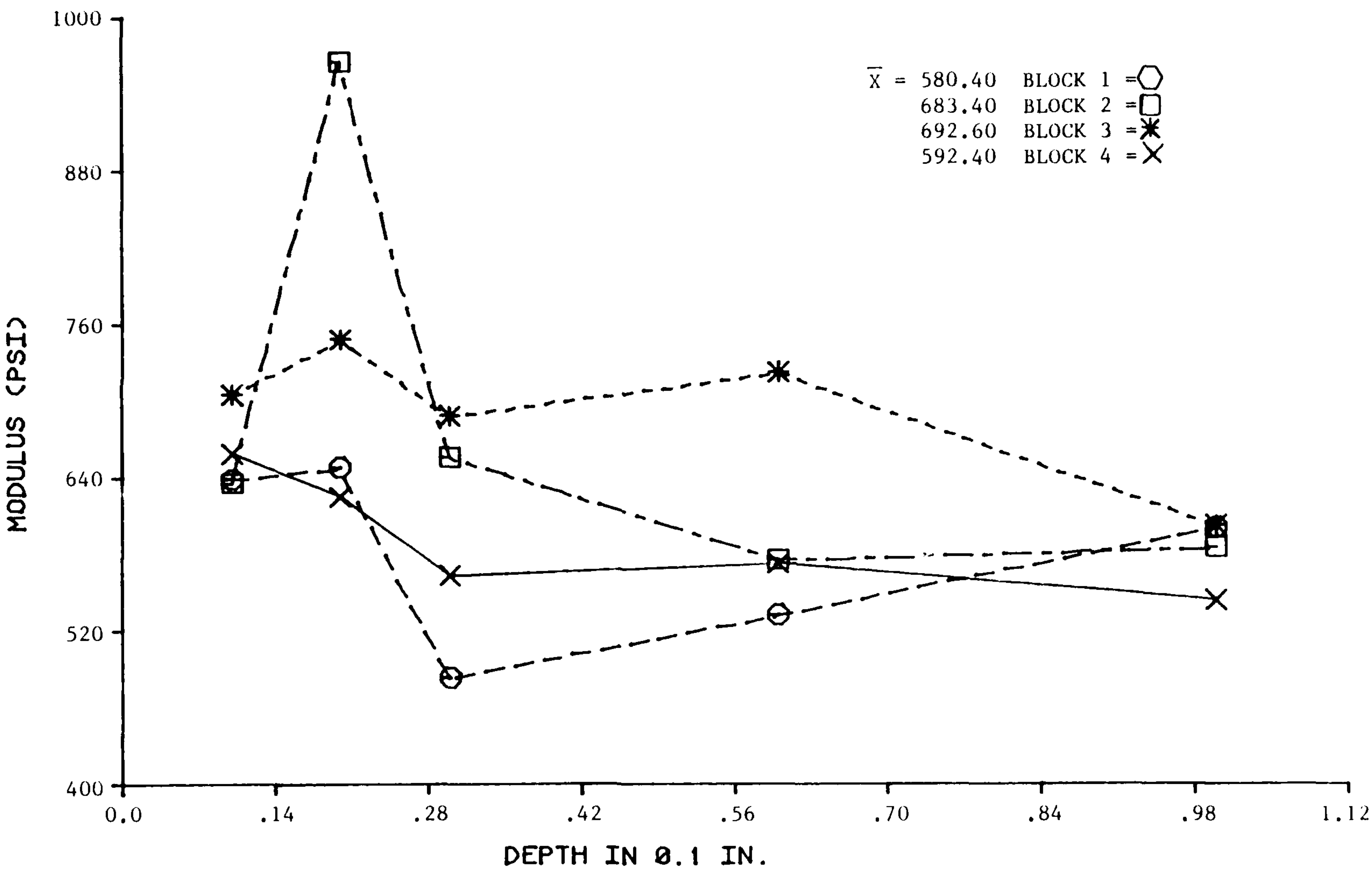
INNER,COND. PROPELLANT, MINITHIN STRS. @ RUPT. VALUES COMPARED 4 BLOCKS

FIGURE 61



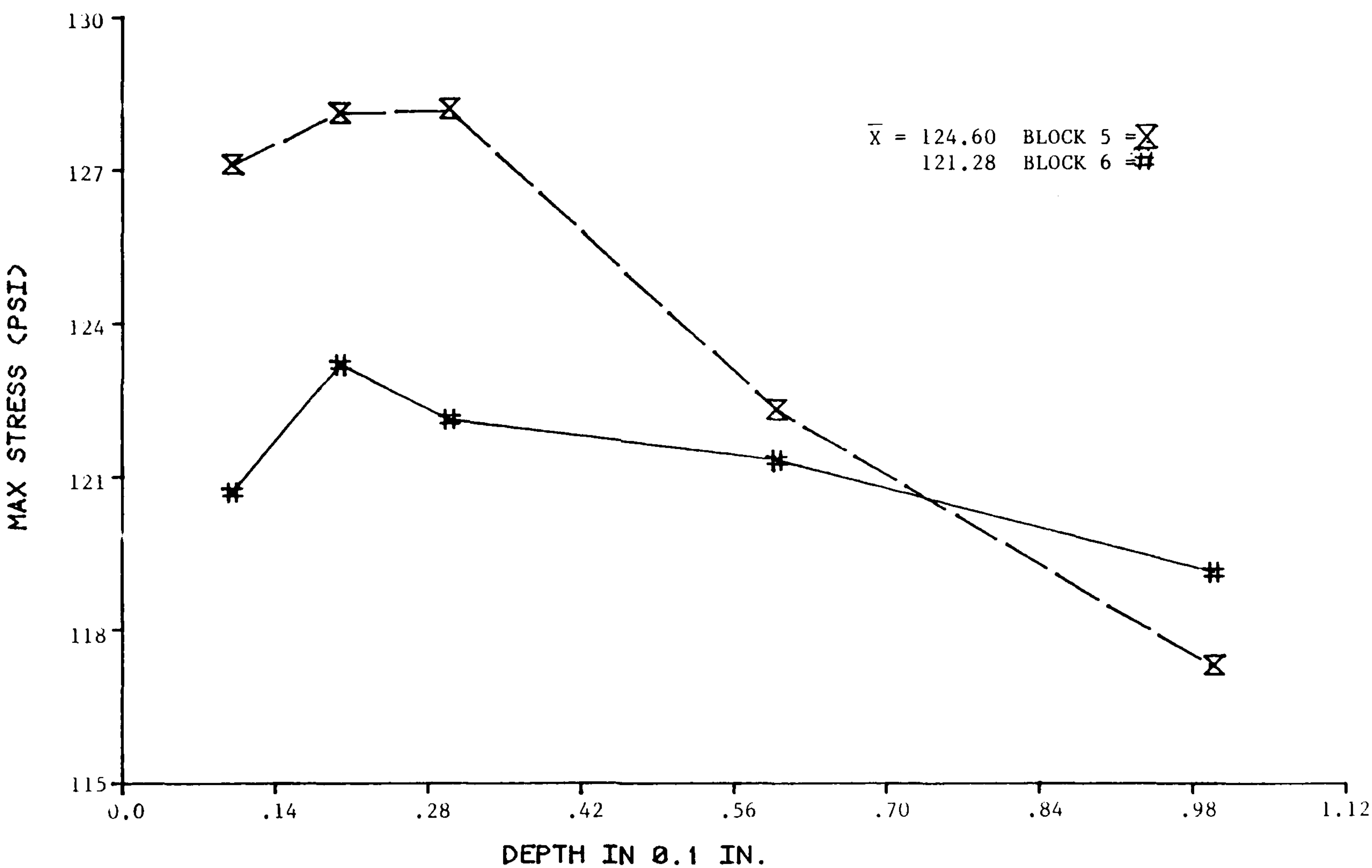
INNER, COND. PROPELLANT, MINITHIN STRN. AT RUPT. VALUES COMPARED 4 BLOCKS

FIGURE 62



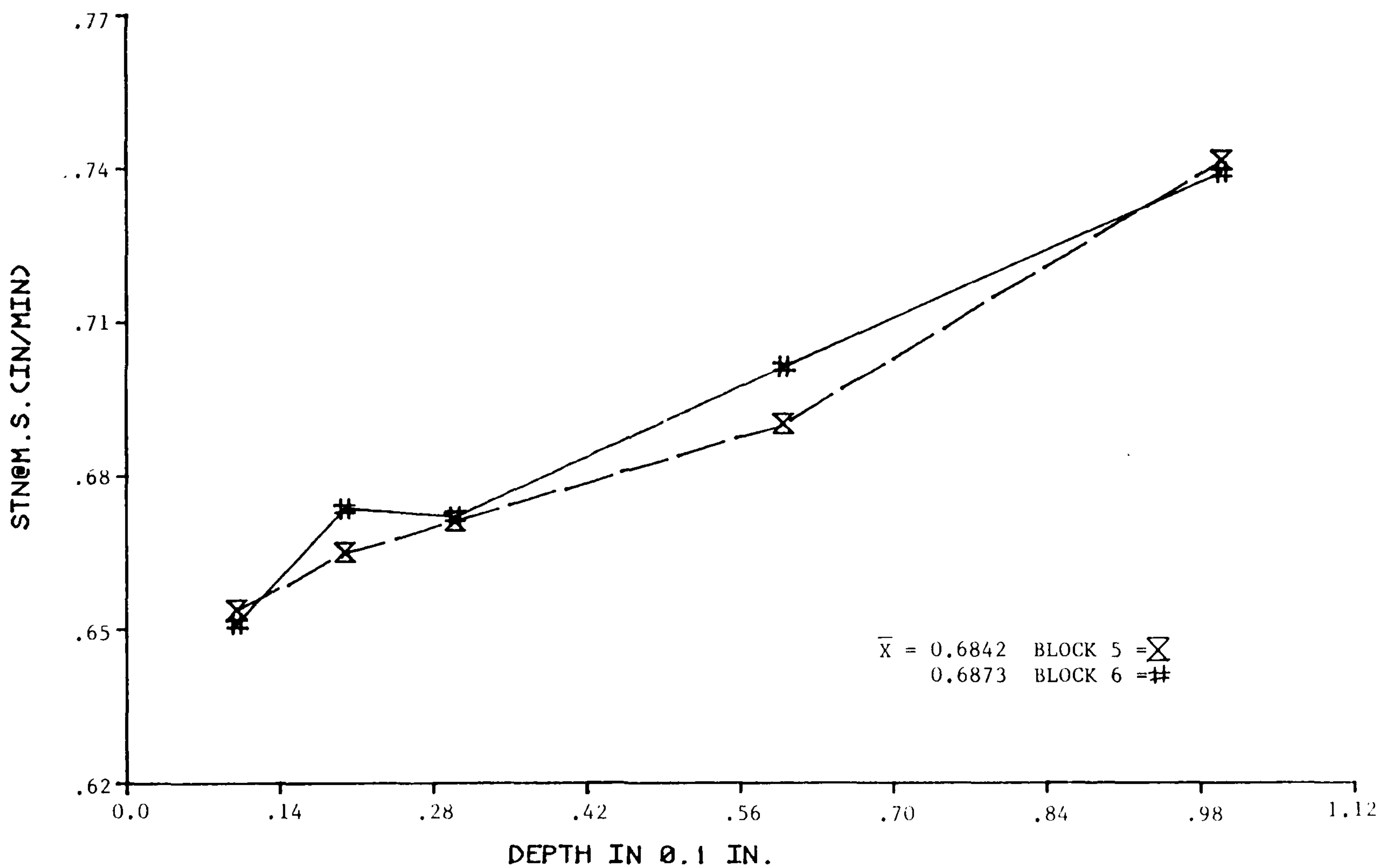
INNER, COND. PROPELLANT, MINITHIN MODULUS VALUES COMPARED 4 BLOCKS

FIGURE 63



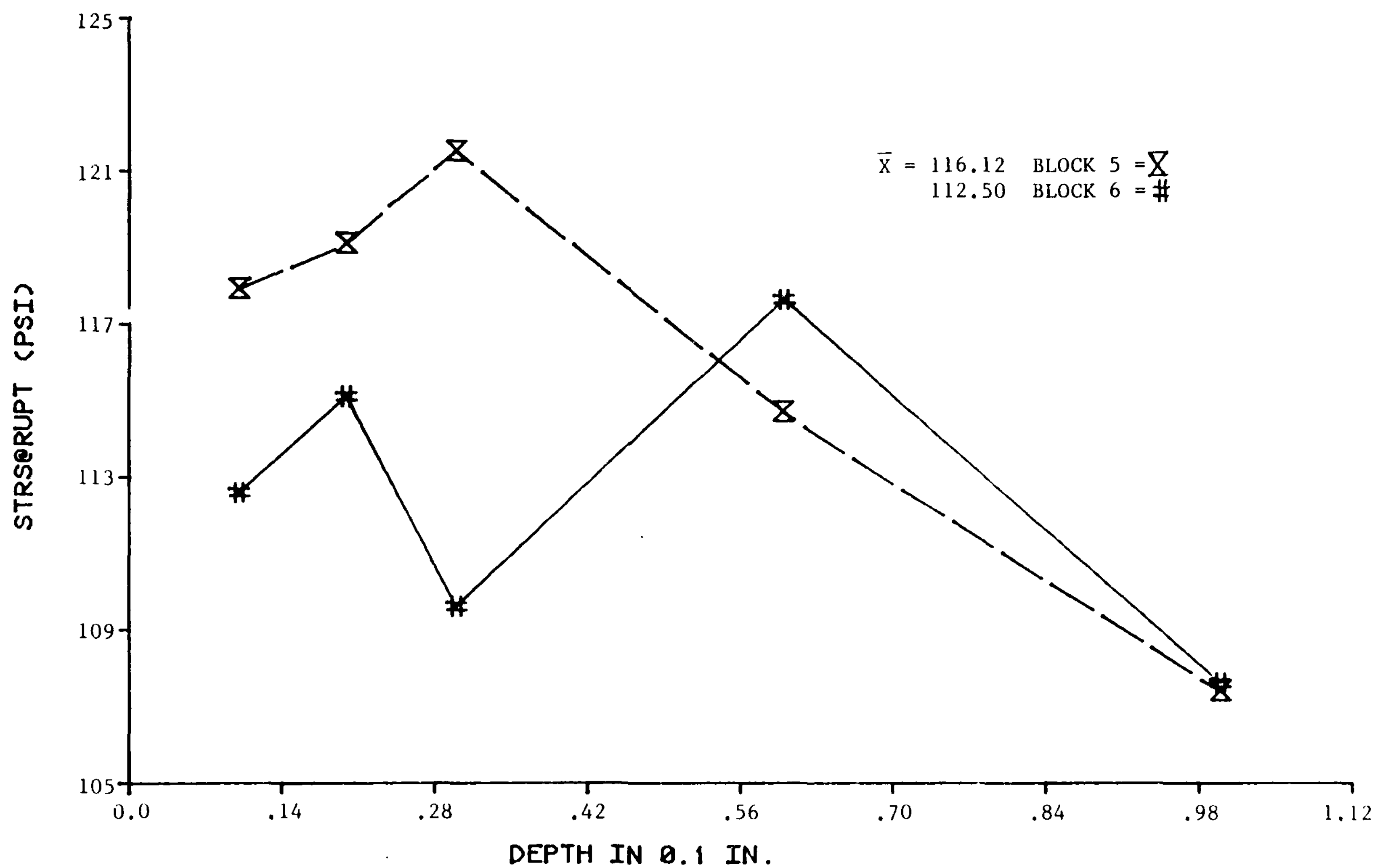
INNER,UNCOND. PROPELLANT, MINITHIN MAX STRESS VALUES COMPARED 2 BLOCKS

FIGURE 64



INNER, UNCOND. PROPELLANT, MINITHIN STRN @ MAX STRS VALUES COMPRD. 2 BLKS

FIGURE 65



INNER, UNCOND. PROPELLANT, MINITHIN STRS @ RUPT. VALUES COMPARED 2 BLOCKS

FIGURE 66

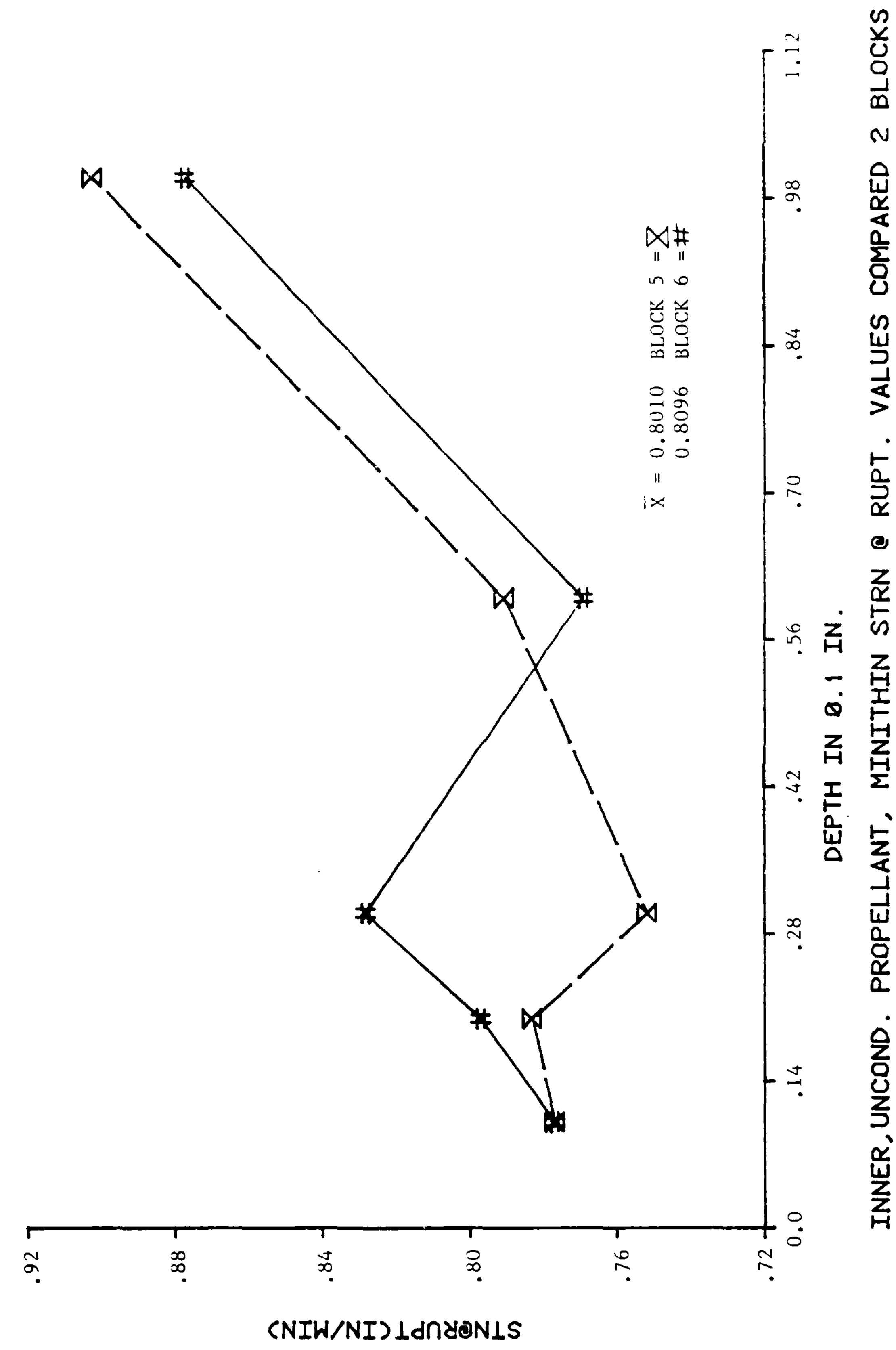
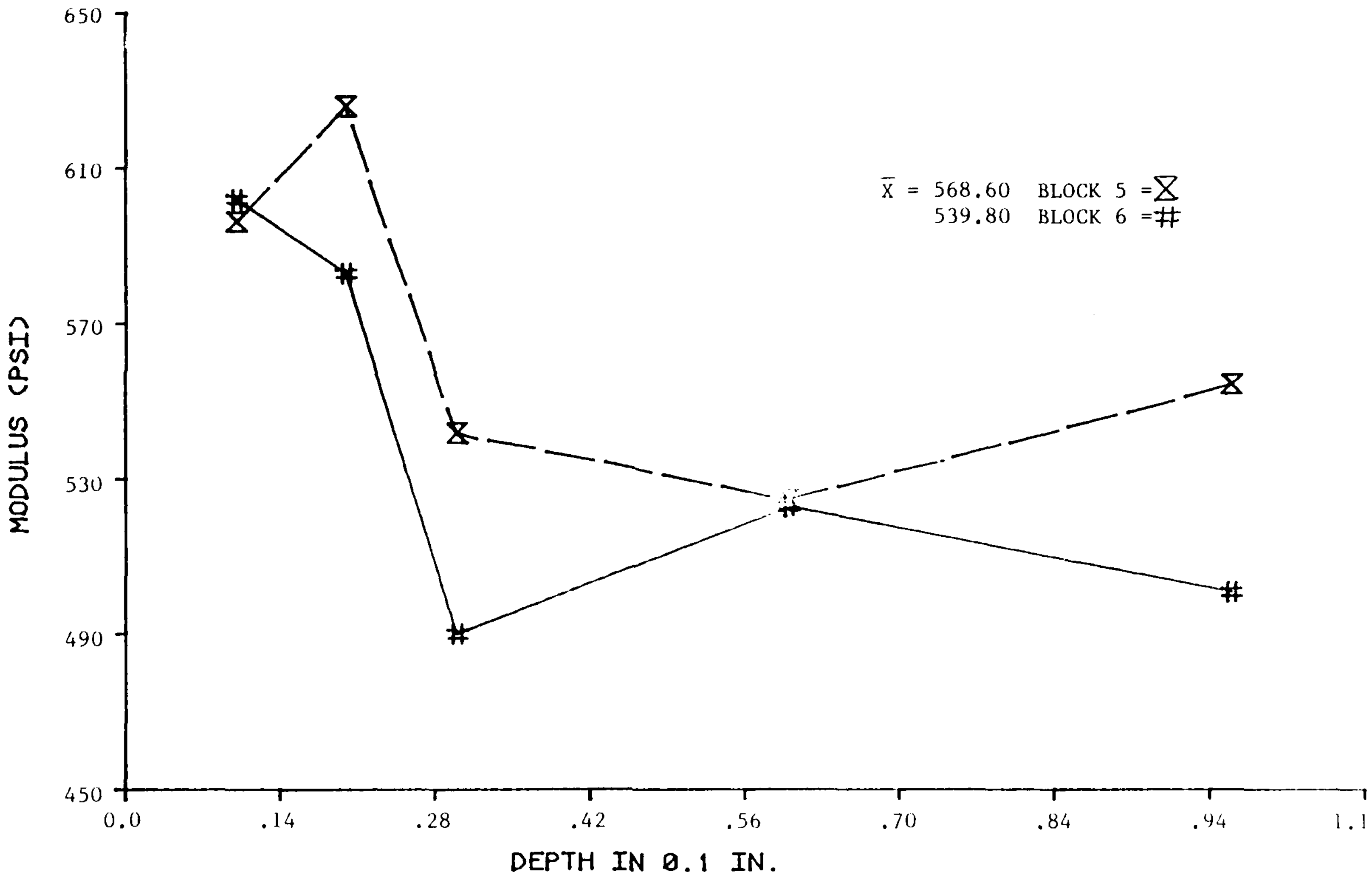

INNER,UNCOND. PROPELLANT, MINITHIN STRN @ RUPT. VALUES COMPARED 2 BLOCKS
DEPTH IN 0.1 IN.
STN@RUPT(IN/MIN)
$\bar{X}$ = 0.8010 BLOCK 5 = ⧖
0.8096 BLOCK 6 = #
0.0 .14 .28 .42 .56 .70 .84 .98 1.12
.72 .76 .80 .84 .88 .92

FIGURE 67



INNER,UNCOND. PROPELLANT, MINITHIN MODULUS VALUES COMPARED 2 BLOCKS

FIGURE 68

TABLE 6
MOTOR 0022687
STRESS RELAXATION
3% STRAIN

UNCONDITIONED ANX (OUTER)

TEMP (°F)		10 SEC	50 SEC	100 SEC	1000 SEC
40		1056	586	486	284
		1121	666	557	338
	$\bar{X}$ =	1088.5	626.0	521.5	311.0
	SD =	45.96	56.57	50.20	38.18
77		550	379	338	252
		544	371	330	252
	$\bar{X}$ =	547.0	375.0	334.0	252.0
	SD =	4.24	5.66	5.66	0
120		347	277	258	210
		297	234	215	178
	$\bar{X}$ =	322.0	255.5	236.5	194.0
	SD =	35.36	30.41	30.41	22.63

CONDITIONED

TEMP (°F)		10 SEC	50 SEC	100 SEC	1000 SEC
0		3418	1801	1432	680
		3460	1865	1472	757
		3530	1922	1546	779
		3547	1930	1524	748
		3884	2130	1701	844
		3607	1919	1510	742
	$\bar{X}$ =	3574.3	1927.8	1530.8	758.3
	SD =	165.64	110.47	92.62	53.44
20		1314	739	606	336
		1401	828	692	408
		1315	777	651	388
		1507	868	651	388
		1655	959	803	478
		1677	958	801	476
	$\bar{X}$ =	1478.2	854.8	712.2	418.2
	SD =	161.97	91.5	79.53	54.[illegible]
40		785	458	386	[illegible]
		845	526	448	[illegible]
		888	555	471	[illegible]
		912	571	487	
		983	616	519	
		945	595	503	
	$\bar{X}$ =	893.0	555.2	469.[illegible]	
	SD =	70.93	52.89	[illegible]	

AD-A190 771 LGM-30B STAGE II DISECTED MOTOR TEST REPORT(U) OGDEN AIR LOGISTICS CENTER HILL AFB UT PROPELLANT ANALYSIS LAB OCT 87 MAQCP-NR-528(87) 2/2

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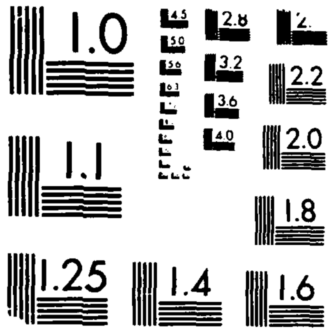


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

TABLE 6 (CONT'D)
MOTOR 0022687
STRESS RELAXATION
3% STRAIN

CONDITIONED

TEMP (°F)		10 SEC	50 SEC	100 SEC	1000 SEC
77		393	275	249	190
		460	322	287	218
		475	336	301	227
		492	348	314	241
		529	375	336	257
		528	372	332	255
	$\bar{X}$ =	479.5	338.0	303.2	231.3
	SD =	50.68	37.02	32.33	25.37
120		258	202	187	153
		294	232	214	170
		292	235	218	176
		311	250	233	188
		341	275	255	201
		344	274	257	209
	$\bar{X}$ =	306.7	244.7	227.3	183.7
	SD =	32.67	27.87	26.72	20.18
160		243	196	187	148
		240	195	179	132
		249	200	186	136
		241	191	176	131
		254	201	186	131
		246	199	185	145
	$\bar{X}$ =	245.5	197.0	181.2	137.2
	SD =	5.32	3.74	5.12	7.52

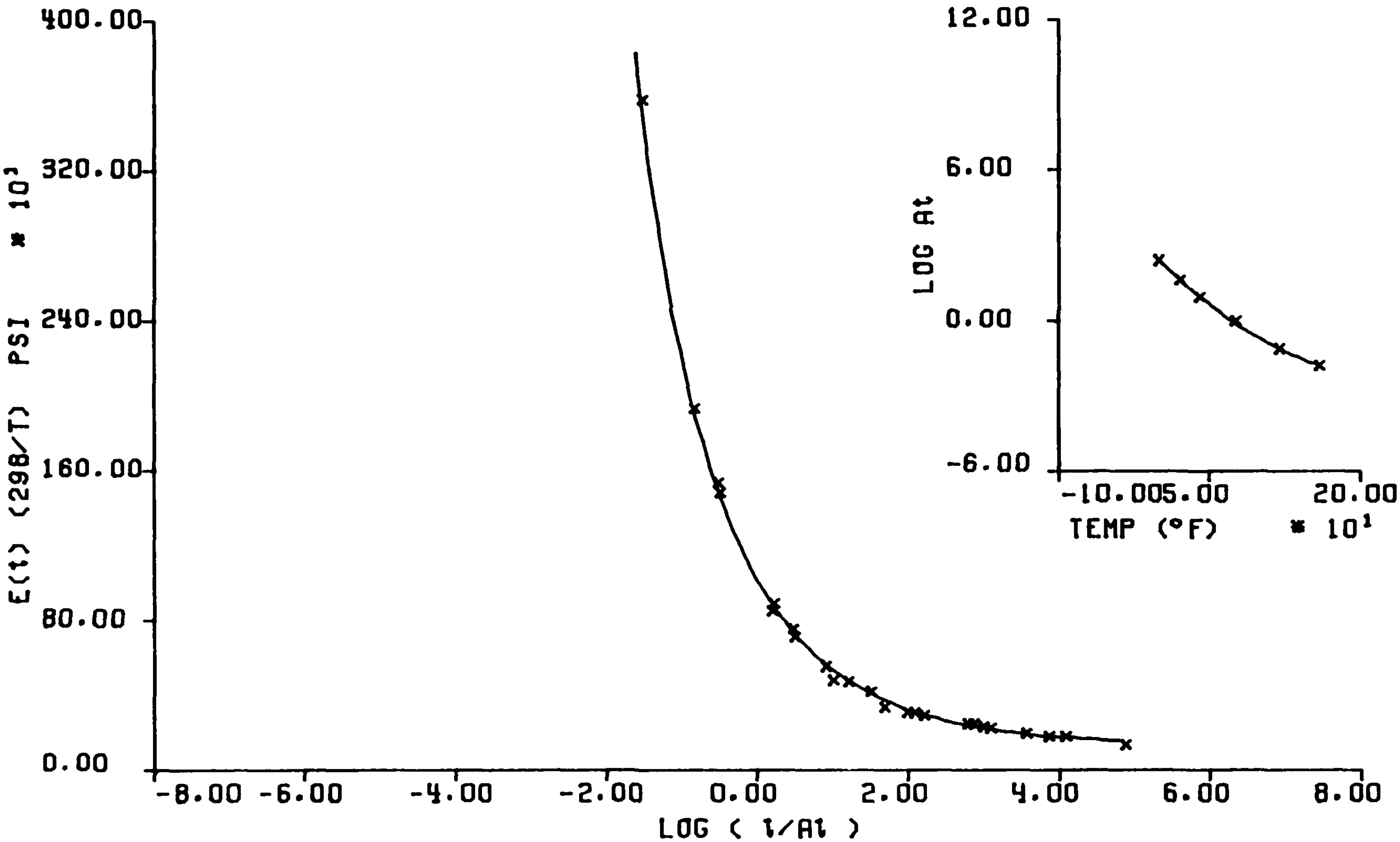
UNCONDITIONED ANY (INNER)

TEMP (°F)		10 SEC	50 SEC	100 SEC	1000 SEC
40		939	538	443	261
		970	558	450	263
		925	547	444	266
	$\bar{X}$ =	944.7	547.7	445.7	263.3
	SD =	23.09	10.02	3.79	2.52
77		406	266	231	165
		451	296	262	194
		467	312	275	203
	$\bar{X}$ =	441.3	291.3	256	187.3
	SD =	31.63	23.35	22.61	19.86

TABLE 6 (CONT'D)
MOTOR 0022687
STRESS RELAXATION
3% STRAIN

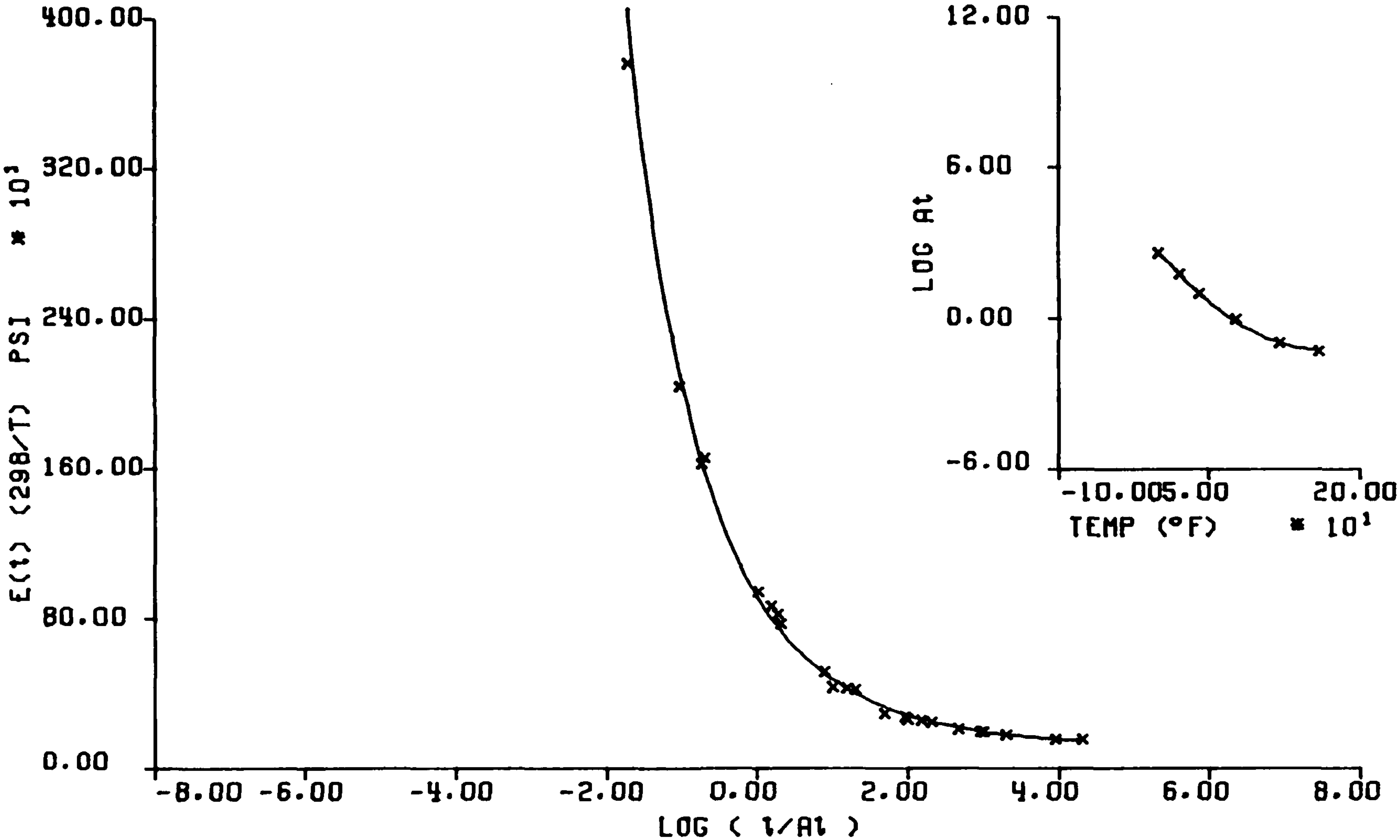
CONDITIONED ANY (INNER)

TEMP (°F)		10 SEC	50 SEC	100 SEC	1000 SEC
120		271	203	192	153
		294	222	205	166
		264	203	186	148
		289	223	204	158
		291	223	203	162
		261	197	181	148
	$\bar{X}$ =	278	211.8	195.2	155.8
	SD =	14.69	12.07	10.30	7.44
160		251	205	188	161
		253	207	189	162
		242	194	180	152
		241	192	179	158
		266	212	200	159
		205	162	150	136
	$\bar{X}$ =	243.0	195.3	181.0	154.7
	SD =	20.70	18.06	16.97	9.79



STAGE II DISCTED MOTOR(0022687), OUTER,3% STRAIN, MASTER STRESS RELAXATION,1986

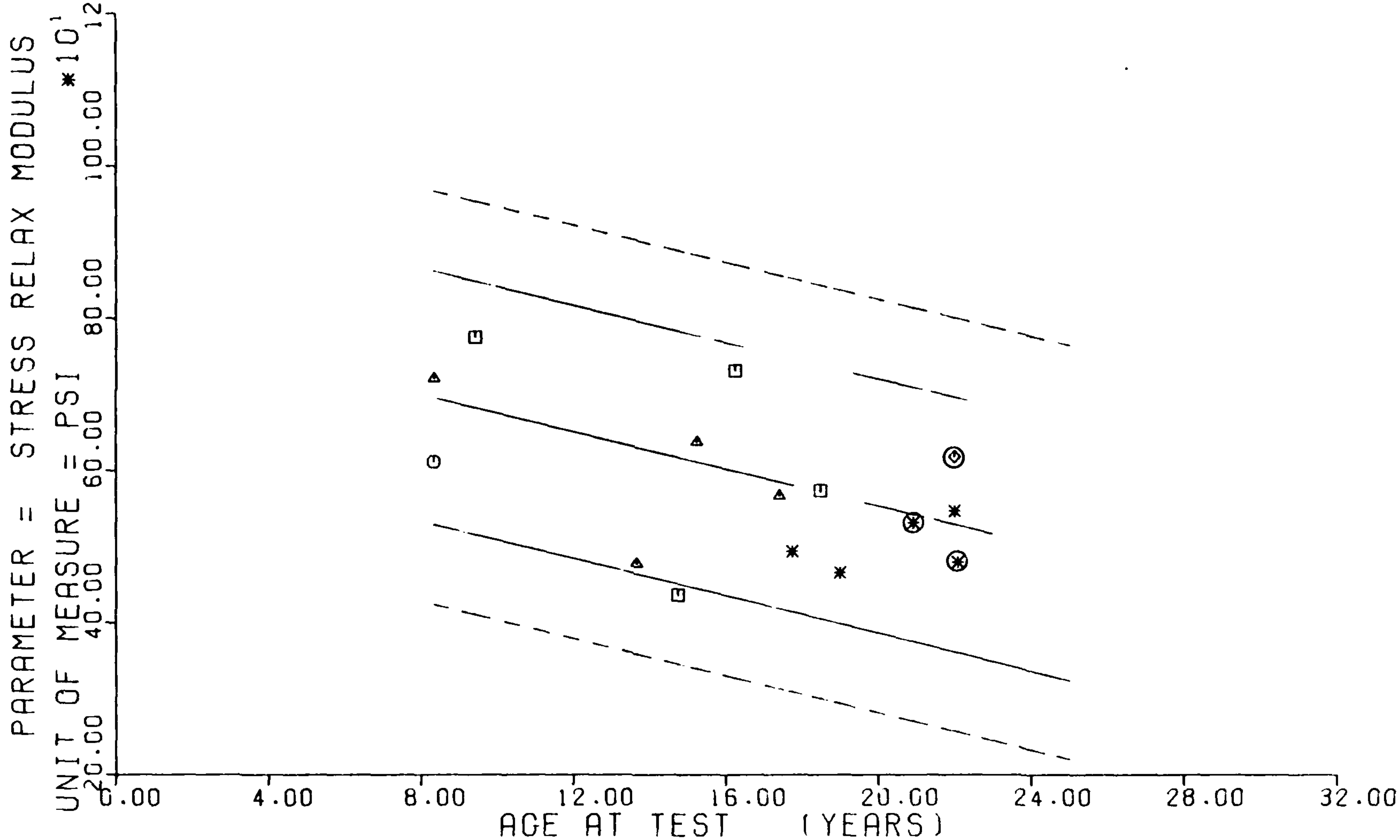
FIGURE 69



STAGE II DISCTED MOTOR(0022687), INNER,3% STRAIN, MASTER STRESS RELAXATION,1986.

FIGURE 70

Y = ((+7.9689346E+02) + (-1.0168447E+00) * X)
F = +6.3684539E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +1.1561892E+02
R = -6.2759974E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +1.2742001E-01
t = +7.9802593E+00 SIGNIFICANCE OF t = SIGNIFICANT S_E = +9.0471605E+01
N = 100 DEGREES OF FREEDOM = 98
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = TEMP +77 DEG F.



STAGE II,DISSECTED MTRS,OUTER,STRESS RELAXATION,3 PERCENT,+77 DEG,10/SEC.

FIGURE 71

Y = ((+6.0140190E+02) + (-8.3719881E-01) * X)

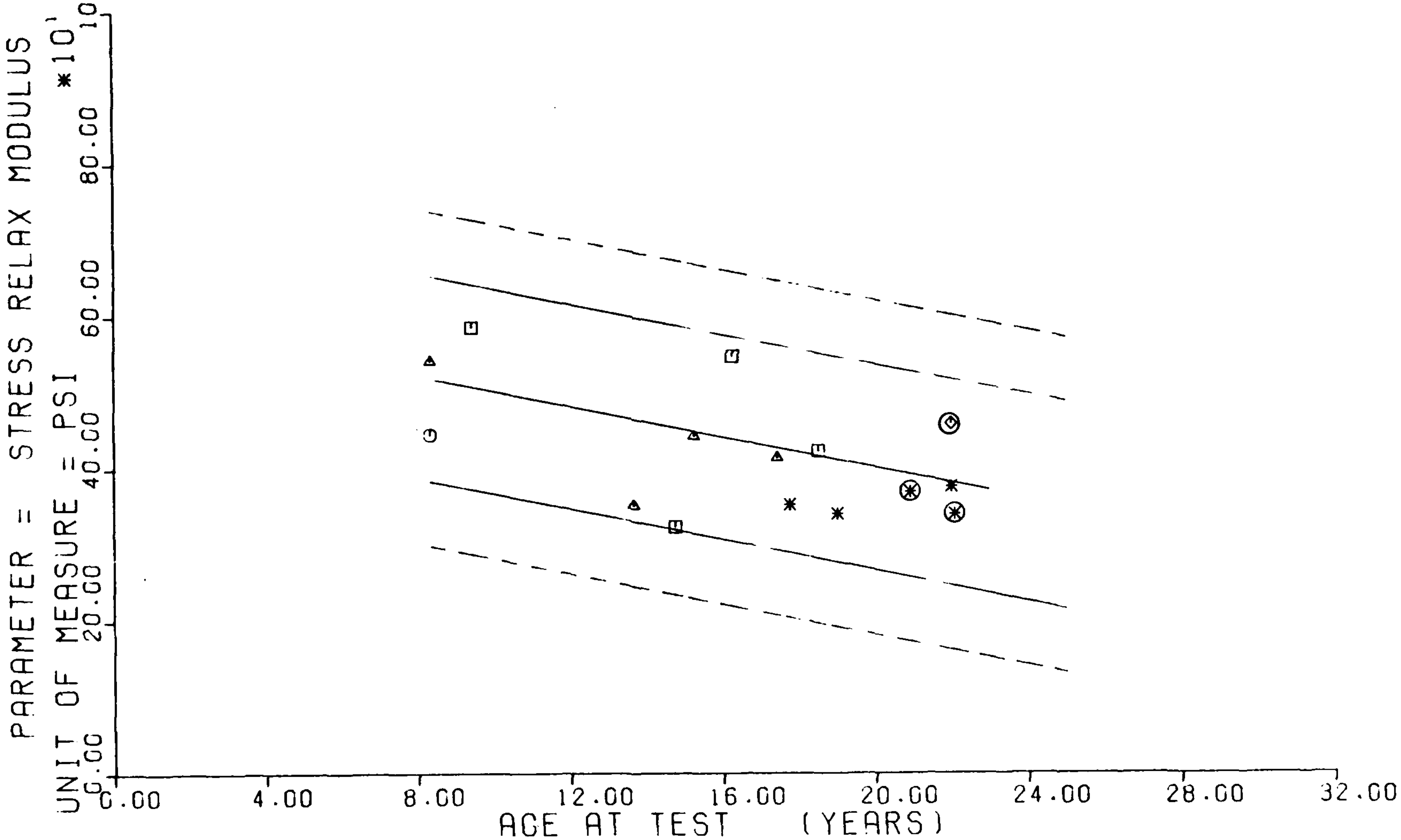
F = +6.6241655E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +9.4072291E+01

R = -6.3507341E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +1.0286390E-01

t = +8.1388976E+00 SIGNIFICANCE OF t = SIGNIFICANT S_E = +7.3036114E+01

N = 100 DEGREES OF FREEDOM = 98

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = TEMP +77 DEG F.



STAGE II.DISSECTED MTRS.OUTER.STRESS RELAXATION.3 PERCENT.+77 DEG.50/SEC.

FIGURE 72

Y = ((+5.5058845E+02) + (-7.8577969E-01) * X)

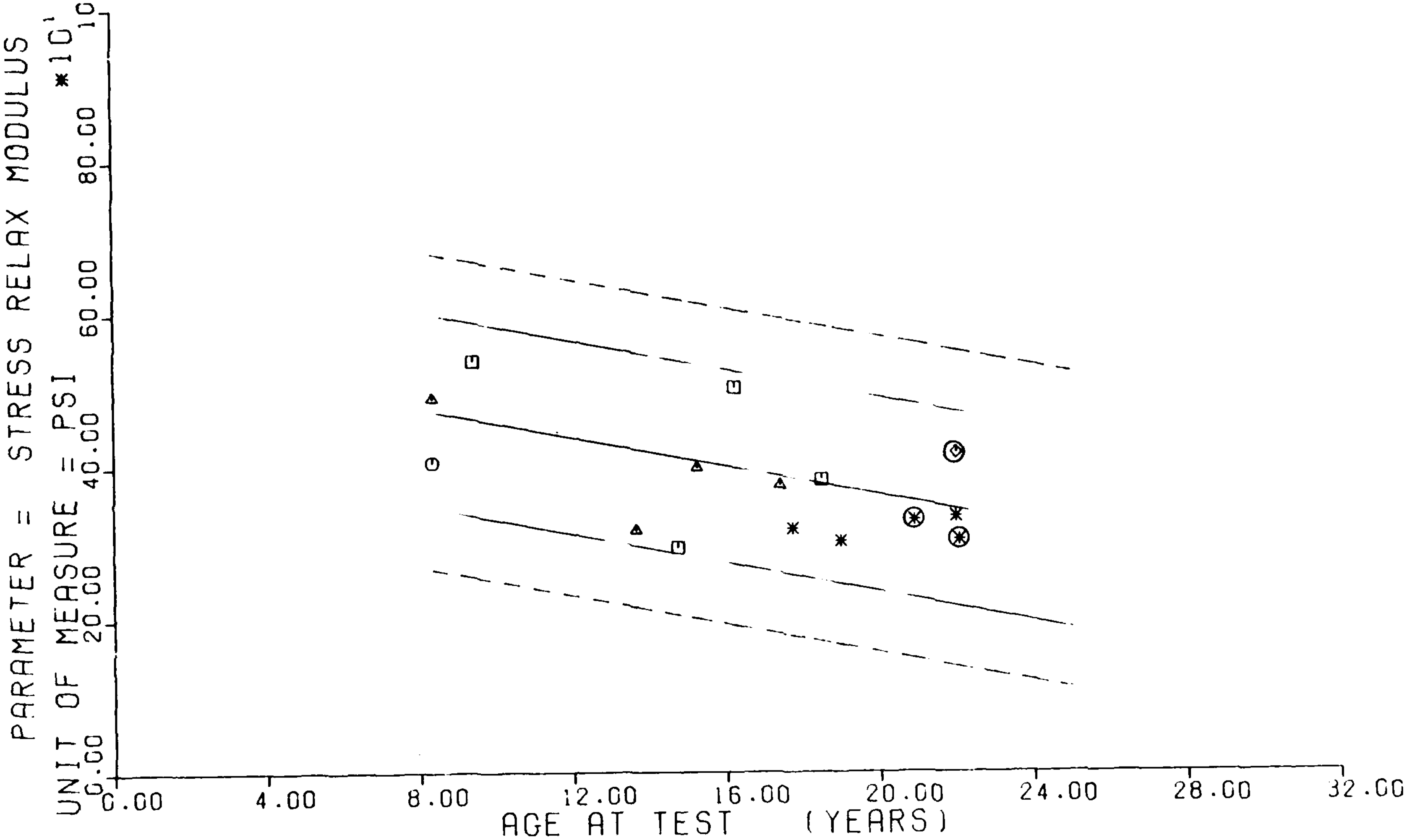
F = +6.5987624E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +8.8395904E+01

R = -6.3434527E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +9.6731863E-02

t = +8.1232767E+00 SIGNIFICANCE OF t = SIGNIFICANT S_E = +6.8682201E+01

N = 100 DEGREES OF FREEDOM = 98

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = TEMP +77 DEG F.

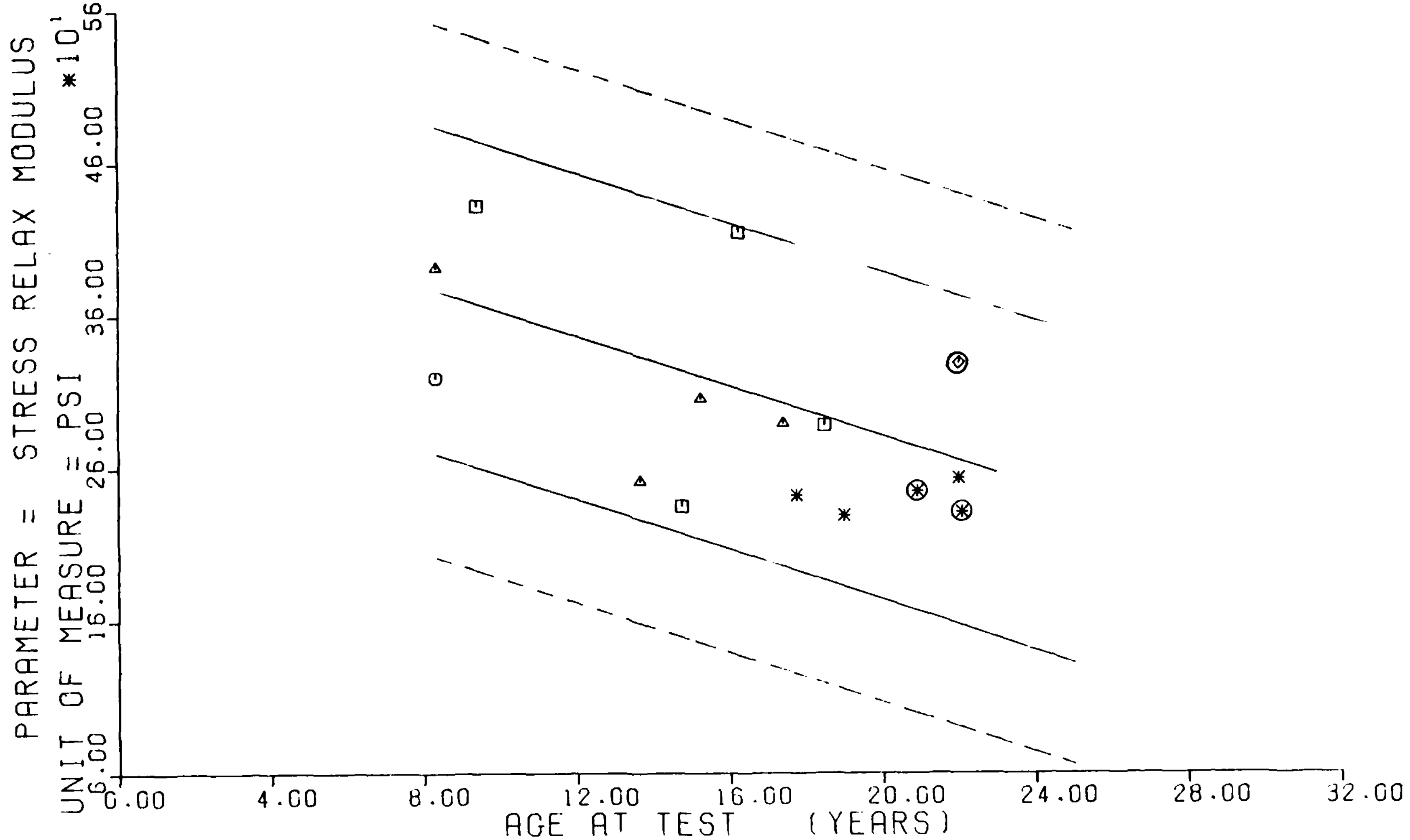


STAGE II, DISSECTED MTRS, OUTER, STRESS RELAXATION, 3 PERCENT, +77 DEG, 100/SEC.

FIGURE 73

Y = ((+4.4445690E+02) + (-6.8106444E-01) * X)

F = +6.9041399E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +7.5596646E+01
R = -6.4289897E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +8.1965939E-02
ι = +8.3091154E+00 SIGNIFICANCE OF ι = SIGNIFICANT S_E = +5.8198000E+01
N = 100 DEGREES OF FREEDOM = 98
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = TEMP +77 DEG F.



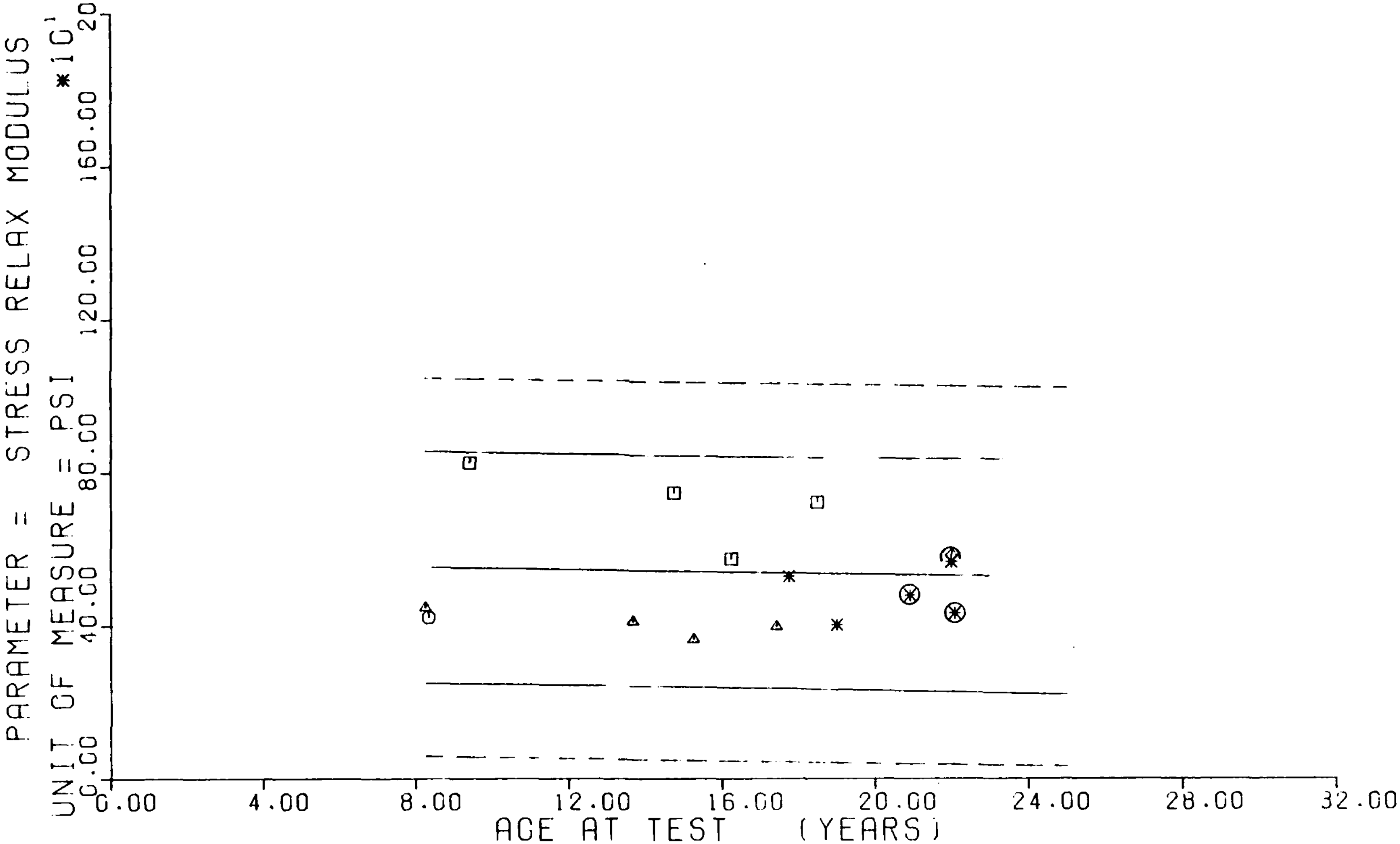
STAGE II,DISSECTED MTRS,OUTER,STRESS RELAXATION,3 PERCENT,+77 DEG,1000/SEC.

FIGURE 74

Y = ((+5.6595126E+02) + (-1.3470460E-01) * X)

F = +3.2924352E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +1.6394737E+02
R = -5.7865175E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +2.3475985E-01
t = +5.7379746E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT σ_E = +1.6450561E+02
N = 100 DEGREES OF FREEDOM = 98

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = TEMP +77 DEG F.



STAGE II,DISSECTED MTRS,INNER,STRESS RELAXATION,3 PERCENT,+77 DEG,10/SEC.

FIGURE 75

Y = ((+4.1848591E+02) + (-1.7209253E-01) * X)

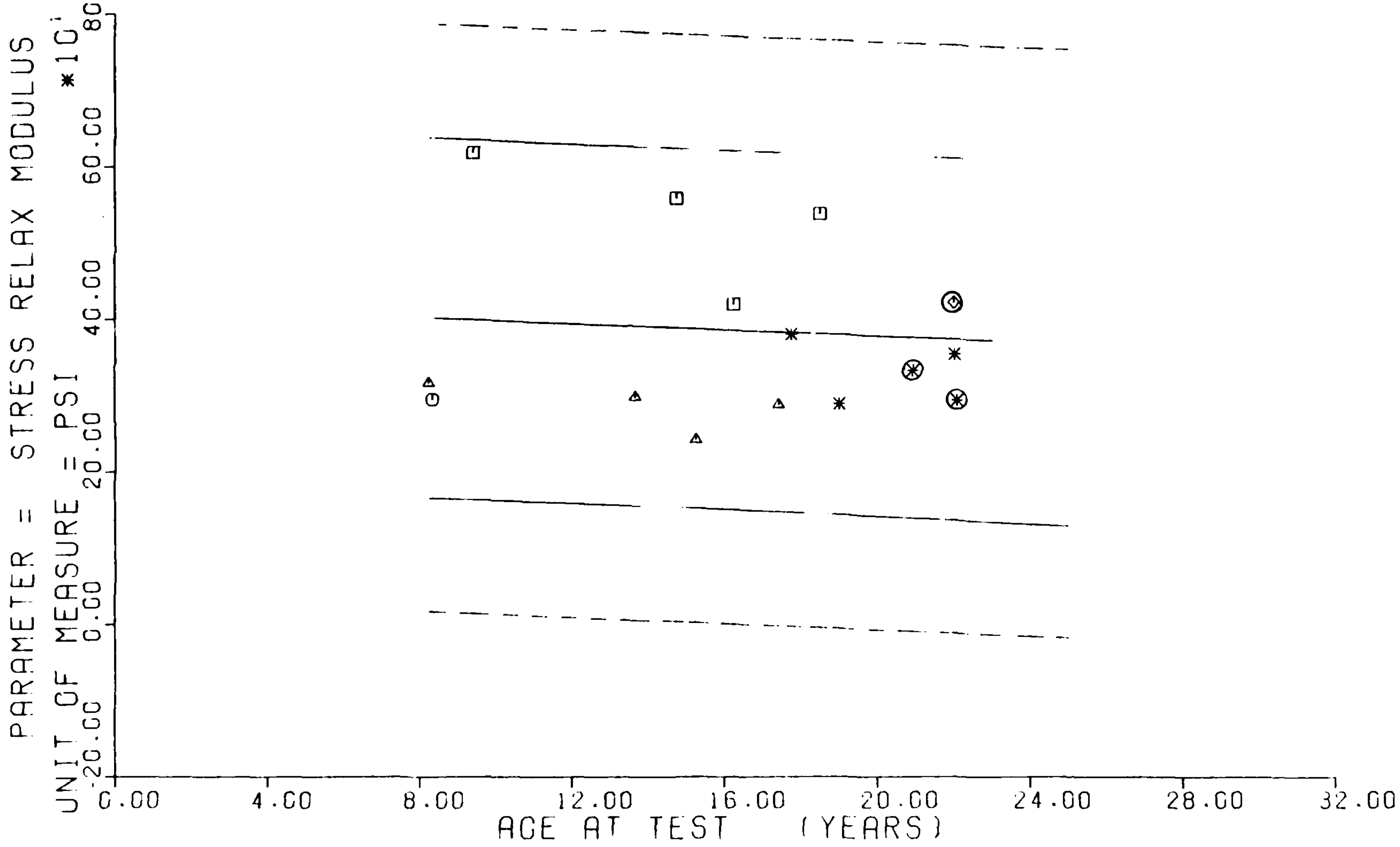
F = +8.8354280E-01 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +1.2821816E+02

R = -9.4526110E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +1.8308309E-01

t = +9.3996957E-01 SIGNIFICANCE OF t = NOT SIGNIFICANT S_t = +1.2829364E+02

N = 100 DEGREES OF FREEDOM = 98

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = TEMP +77 DEG F



STAGE II,DISSECTED MTRS,INNER,STRESS RELAXATION,3 PERCENT,+77 DEG,50/SEC.

FIGURE 76

Y = ((+3.7894880E+02) + (-1.6995280E-01) * X)

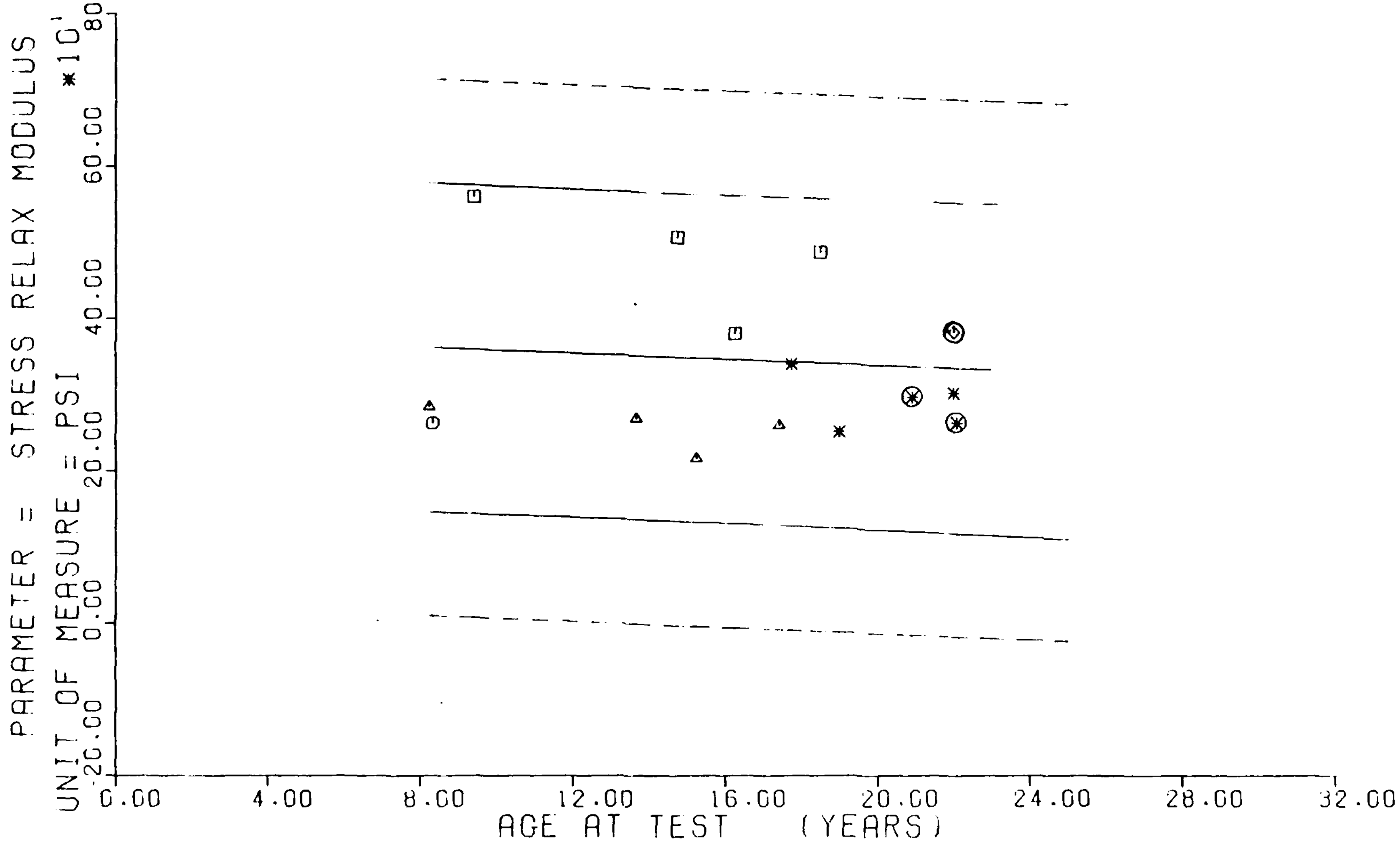
F = +1.0304537E+00 SIGNIFICANCE OF F = NOT SIGNIFICANT σ_Y = +1.1733774E+02

R = -1.0200697E-01 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +1.6742259E-01

t = +1.0151126E+00 SIGNIFICANCE OF t = NOT SIGNIFICANT S_E = +1.1731970E+02

N = 100 DEGREES OF FREEDOM = 98

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = TEMP +77 DEG F.



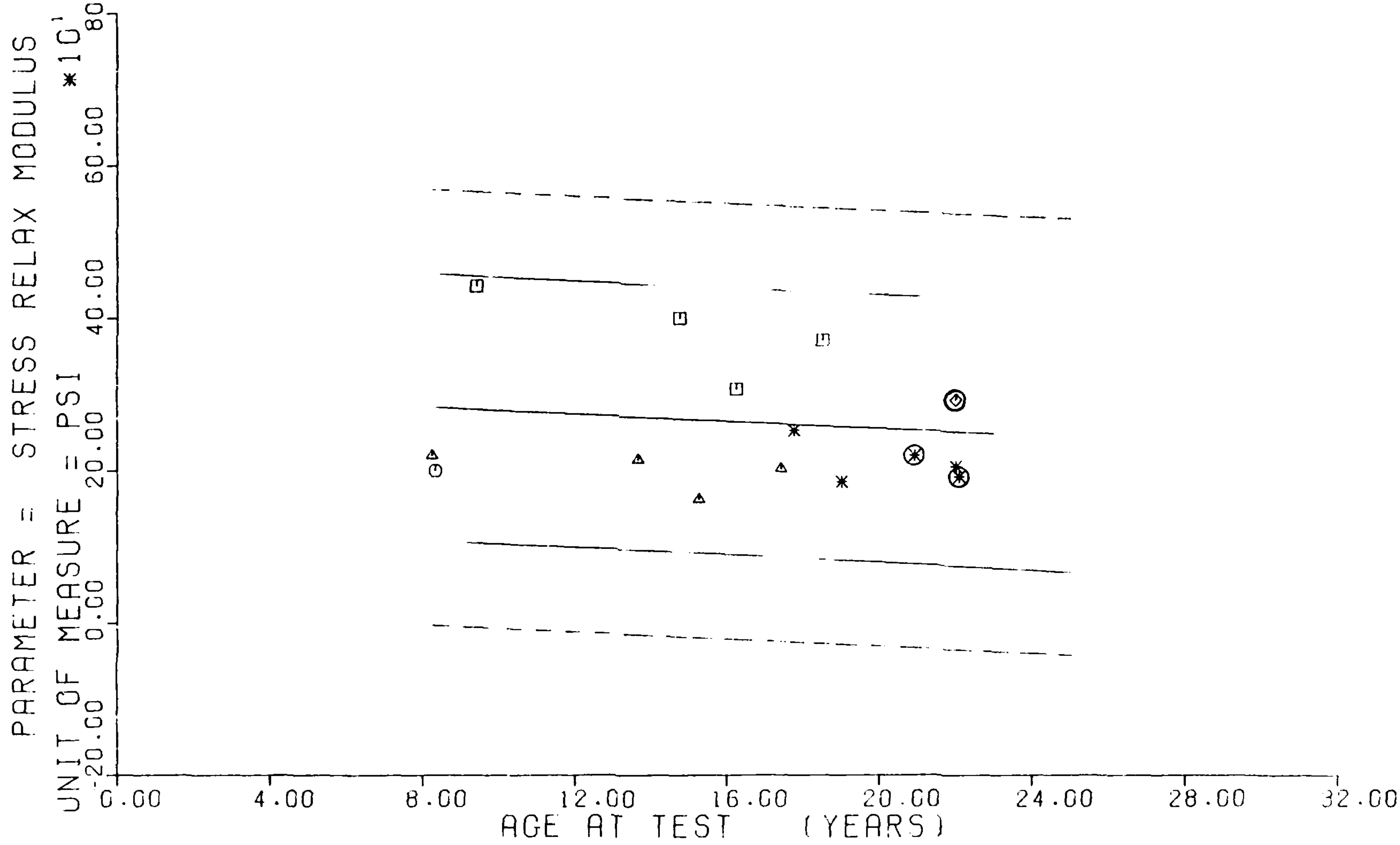
STAGE II, DISSECTED MTRS, INNER, STRESS RELAXATION, 3 PERCENT, +77 DEG, 100/SEC.

FIGURE 77

$$Y = ((+3.0214248E+02) + (-1.9550318E-01) * X)$$

F = +2.0684880E+00	SIGNIFICANCE OF F = NOT SIGNIFICANT	σ_Y = +9.5766867E+01
R = -1.4377316E-01	SIGNIFICANCE OF R = NOT SIGNIFICANT	S_B = +1.3593375E-01
t = +1.4382239E+00	SIGNIFICANCE OF t = NOT SIGNIFICANT	S_E = +9.5254216E+01
N = 100	DEGREES OF FREEDOM = 98	

STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = TEMP +77 DEG F.



STAGE II,DISSECTED MTRS,INNER.STRESS RELAXATION,3 PERCENT,+77 DEG,1000/SEC.

FIGURE 78

TABLE 7
MOTOR 0022687
TCLE

OUTER (ANX)

	Tg		BEFORE Tg $10x^{-5}$ in/min/°C		AFTER Tg $10x^{-5}$ in/in/°C	
	1986	1985	1986	1985	1986	1985
	-56	-57	6.90	6.33	13.44	11.13
	-57	-56	7.17	5.86	12.69	11.01
	-57	-60	7.10	6.34	12.77	10.95
	-57	-58	6.77	5.53	12.91	10.33
	-57	-55	7.26	6.55	12.99	11.71
	-57	-53	6.74	6.16	13.10	12.32
		-55		6.19		11.32
$\overline{X}$	-56.83	-56.28	6.99	6.137	12.968	11.253
SD	.408	2.288	.2174	.341	.2626	.

INNER (ANY)

	Tg 1986	Tg 1985	Before 1986	Before 1985	After 1986	After 1985
	-58	-56	7.99	6.32	13.81	10.28
	-56	-58	8.07	5.77	14.19	11.17
	-57	-57	8.32	6.22	14.98	11.03
		-59		5.77		10.48
		-59		6.33		10.81
		-56		7.11		11.10
$\overline{X}$	-57	-57.5	8.127	6.235	14.327	10.812
SD	1.0	7.378	.1721	.4548	.5969	.3611

TABLE 8

MOTOR 0022687
HARDNESS

Specimen Location	Unconditioned Initial	Unconditioned 10 Sec	Conditioned Initial	Conditioned 10 Sec
Outer (ANX)	66	58	70	60
	66	58	71	60
	68	58	70	63
	68	57	68	59
	65	58	70	60
	68	58	71	62
	70	61	70	62
	67	58	70	60
	69	61	70	62
	68	58	71	62
	68	58	68	60
	67	58	70	68
X =	67.5	58.4	69.9	61.5
SD =	1.38	1.24	0.996	2.39
Inner (ANY)	66	57	68	59
	67	58	67	58
	64	56	66	60
	64	57	71	60
	66	58	69	60
	66	57	69	59
	65	57	68	60
	64	57	67	58
	67	57	70	64
	66	57	71	61
	65	57	71	59
	68	60	69	62
X =	65.7	57.3	68.8	60.0
SD =	1.30	0.98	1.70	1.71

Y = ((+7.0829536E+01) + (-2.9643043E-02) * X)

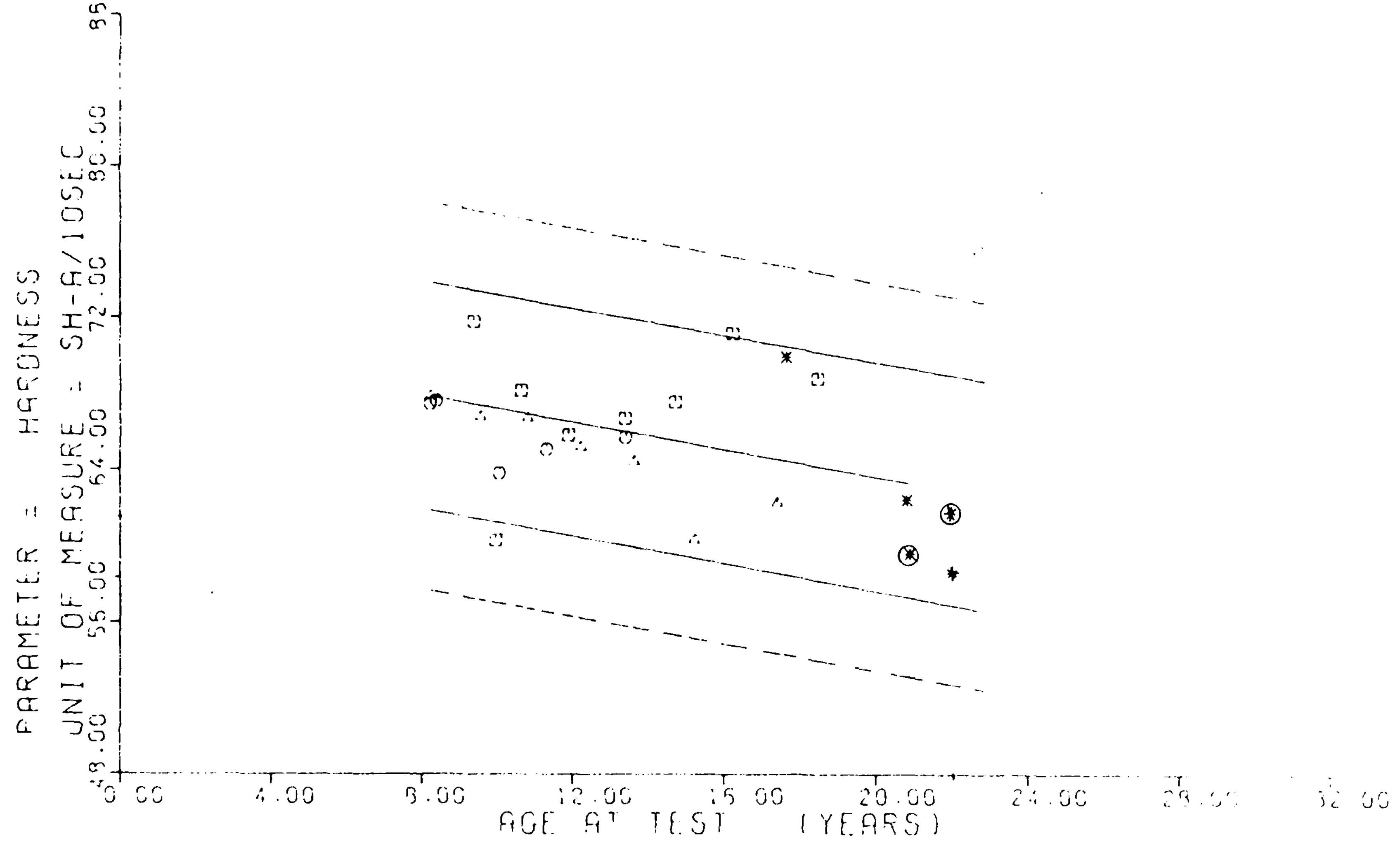
F = +4.2247946E+01 SIGNIFICANCE OF F = SIGNIFICANT σ_Y = +3.6899443E+00

R = 3.3966069E-01 SIGNIFICANCE OF R = SIGNIFICANT S_B = +4.550[illegible]E-03

t = +6.4998420E+00 SIGNIFICANCE OF t = SIGNIFICANT S_Y = +3.404[illegible]E+00

N = 238 DEGREES OF FREEDOM = 236

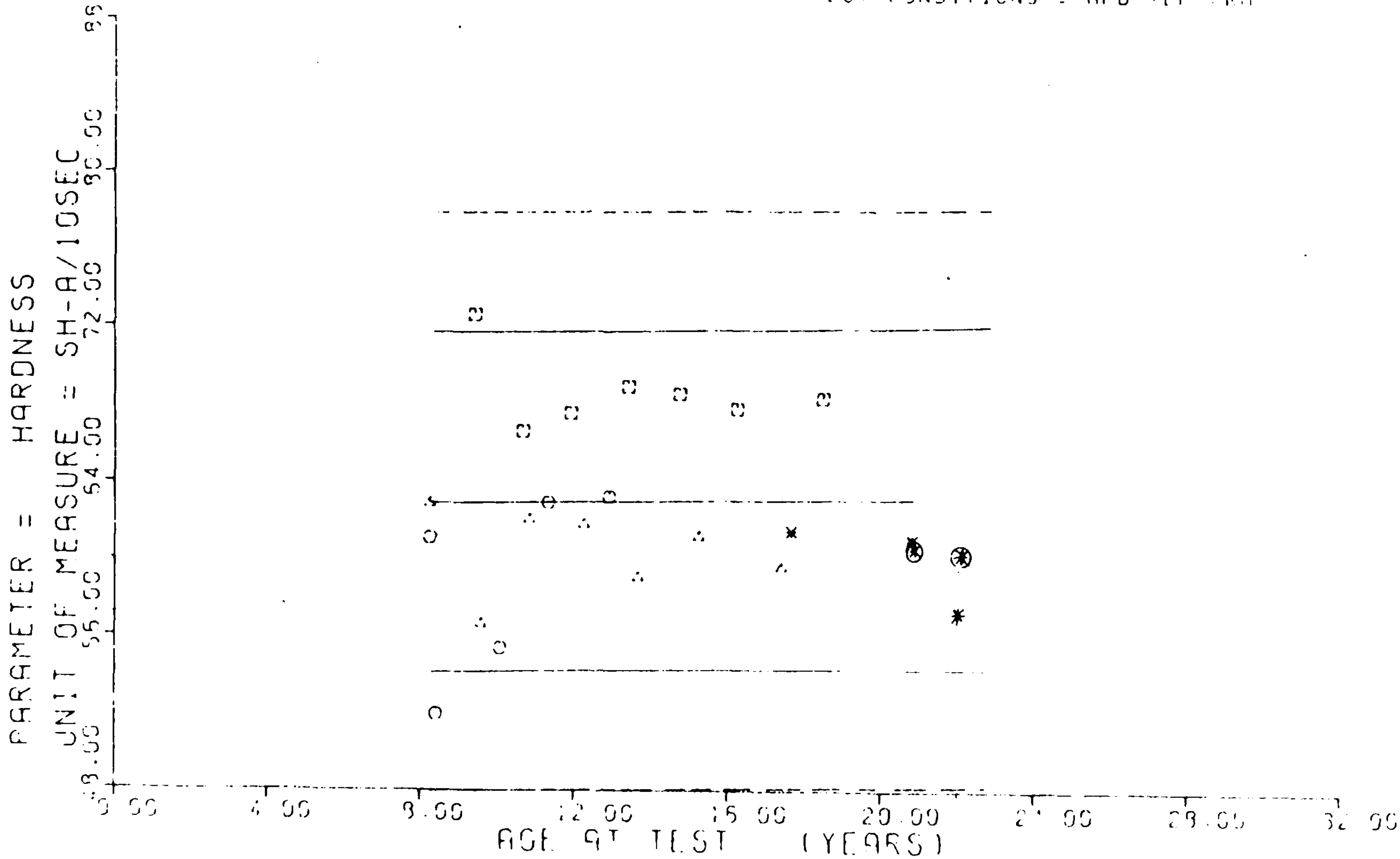
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



II STAGE OSCT MTRS ONLY,OUTER,HARDNESS, AXIAL SHORE-A,10-SEC

FIGURE 79

Y = (+5.2780417E+01) + (+1.7491242E-03) * X)
F = +6.9113332E-02 SIGNIFICANCE OF F = NOT SIGNIFICANT S_Y = +4.0019316E+00
R = +1.6774410E-02 SIGNIFICANCE OF R = NOT SIGNIFICANT S_B = +6.7029925E-03
T = +2.5098530E-01 SIGNIFICANCE OF T = NOT SIGNIFICANT S_E = +5.0015311E+00
N = 244 DEGREES OF FREEDOM = 242
STORAGE CONDITIONS = AMB TEMP/RH TEST CONDITIONS = AMB TEMP/RH



II STAGE DSCT MTRS ONLY.INNER.HARDNESS. AXIAL SHORE-A 10-SEC

FIGURE 80

TABLE 9

MOTOR 0022687

Bond Properties

	Time	Load
Constant Load Tensile		
Log stress (psi) vs	1 min	72.188
Log time to failure (min)	10 min	50.078
	100 min	34.74
	1000 min	24.1

DEFINITION OF THE CONSTANT LOAD EQUATIONS

The constant load equation is written in terms of log values for two variables, log time to failure on X and log stress on Y. The regression equation, $Y = a + bX$ then becomes $\log Y = a + \log X$ which is the sample regression line, where b is the slope of the regression line and a is the Y intercept. After regression analysis is performed on these log values for each set of data, the equation is set equal to the desired log time and solved for X. The antilog is taken of both sides of the equation. This provides the stress required to break the case bond at any desired time in minutes.

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